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R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXV NO. 9

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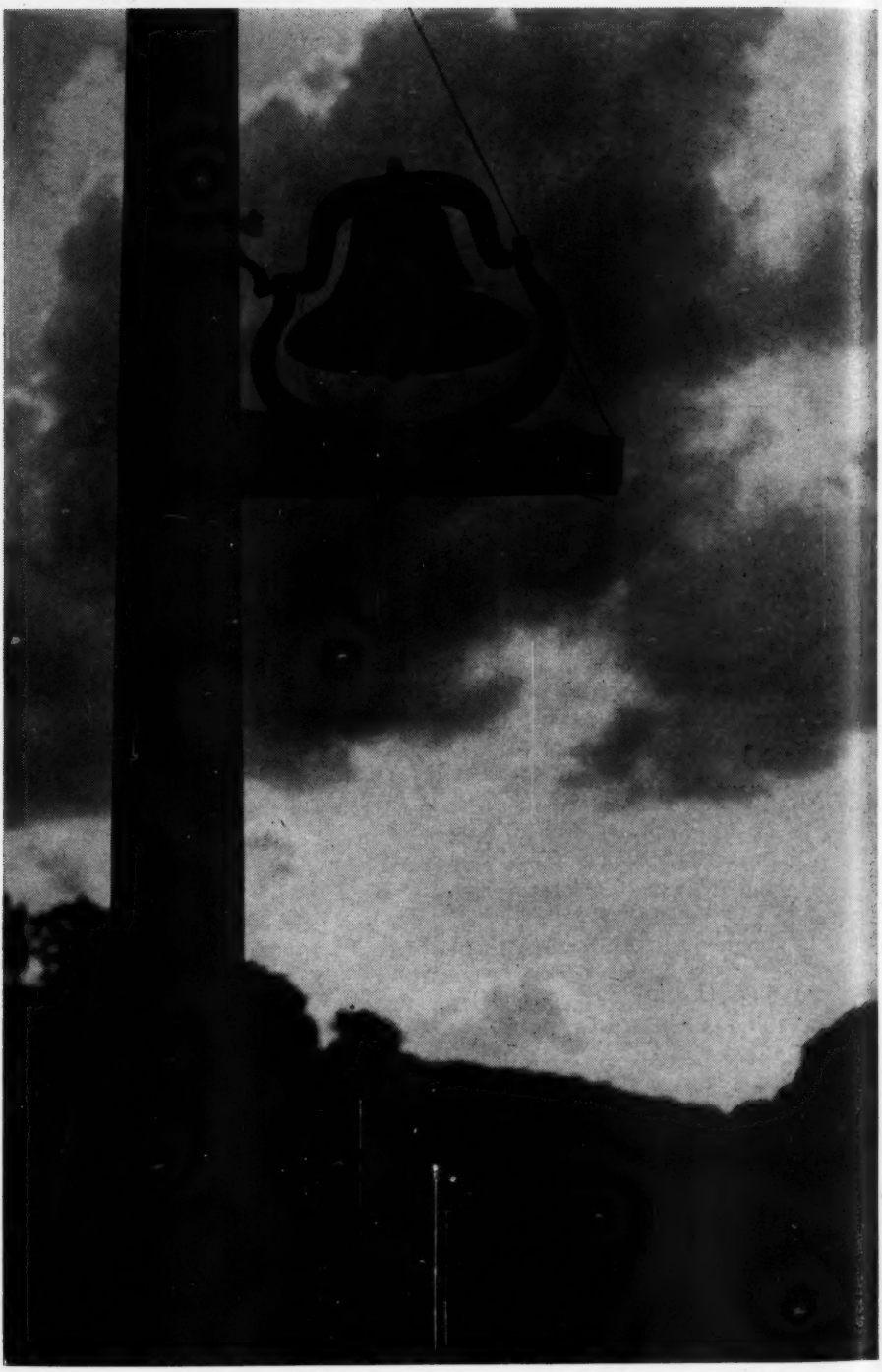

Through—Until Field Work Starts Again!

Better Crops with PLANT FOOD

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VOL. XXXV WASHINGTON, D. C., NOVEMBER 1951 No. 9

Some Pointers on . . .

What's the Right Answer?

Jeff McDermid

COLUMBUS is the only gent I ever heard about who succeeded without much information. He carefully studied what little there was, mixed in some strong faith, and finally gave the old world a new "better half"—a new hemisphere bulging with enough information to last for centuries.

Information is always what most everyone in his right mind seems to want and need and wish for. Information is what causes men to do things, and then makes them better able to accomplish what they set out to do. We must have good information in order to spin and weave fibers and make clothes and repair them; to grow and choose foods wisely and prepare and serve them properly and appetizingly.

Parents starting out without adequate information (gained personally or by somebody's examples) are bereft of the stuff which families thrive on for success, happiness, and comfort. Religion is mostly based on faith—which Paul said is "the substance of things hoped for and the evidence of things not seen." But mankind who never have had information or experience about true Christian principles and character building surely lack any shreds of faith and cannot easily grasp any evidence, either seen or unseen. You must know and understand before you have confidence.

The Bible is a great storehouse of information. It tells about creation, original sin (which happened because of disregard for good information), and the wanderings and searchings of a pastoral people and how they relied

on leadership to bring them safely to the Promised Land. It recites the solemn philosophy of the prophets, without which foundation all our knowledge is crassly material and inadequate for developing the courage and the spirit needed for life's tasks.

The New Testament is a renewal of faith based on historic facts, blended with precepts and parables which themselves are keys to the wisdom of the ages. Deprived of all this, all our modern, everyday information runs the risk of useless or improper application.

THE much-thumbed dictionary is another basic collection of information. This hefty book has to be revised and amended and extended often to keep up with the facts of progress and the new information which any such reliable source must convey. Words, like fashions, often fade and get outmoded, and new ones grow up with which to dress and embellish our mutual understanding.

Likewise, the makers of modern encyclopedias choose to print them in loose-leaf form. Obviously, this is in recognition of the constantly changing picture in the affairs of mankind. Information retailed yesterday must be modified and amplified to make it sound trustworthy today. Nothing is so discouraging as to open a book of knowledge which is as out-of-date as the parliamentary power of Joe Cannon or the Dredd Scott decision.

So we clinch one basic principle of information, one that makes it absolutely vital to keep information current and alive: *Information is necessarily a profession just as alert in its own way as the professions of medicine and law.* You can't be an in-and-outer in handling it. No dabblers or pretenders can be tolerated in the field of information, especially in technical lines. Many there are who masquerade as "information specialists" just to get into places of temporary power, where they can pour some effluvia of their own concoction into the springs of information going to the public. But our present difficulty is that we fail to separate the trained and experienced and dedicated information folks from the phonies.

Every large corporation employs staff members of talent and training to analyze and rewrite and distribute facts and data on the operations, inventions, discoveries, innovations, and improvements wherein their firm is taking an active part. This is just as much a modern "must" in business management as the construction of a lathe or a layout for a factory. It isn't just advertising either. It is simonpure information.

Of course, the ebullient advertising fraternity has a background of information always at hand to bolster its language and sales methods, its pictorial and radio and television technique. But advertising per se is not always true information, although based on it. It may be garbled or twisted or emphasized in certain clever ways, to suit the immediate present needs. A majority of advertising systems stick rigidly to proven facts and seldom dally with unsound or romantic and unrealistic themes. But when stripped of the fundamental information itself, sales talks are meaningless and boring, and run counter to opinions of experienced skeptics.

LARGE and small firms, associations, groups, and educational units maintain house organs to acquaint their employees and other "inside" friends with the information that cheers and inspires them to feel they are a part of a growing and a purposeful organization. This also is information jazzed up and made snappy with bright and convincing points, to hold attention and instill faith. Radio programs are built on it too.

So again we mark off a point for you to remember about information: *Information is acutely vital to the transaction of private business.* It is based

on the belief that you can't fool all the people all of the time. It rests on the discovery that secrecy and bluff are poor business promoters.

Generals and diplomats absolutely rely for success on good, sound, on-the-spot information. Its absence ruins many a campaign and frustrates many a hopeful diplomatic mission. Our intelligence service in war or peace is the root of our victory and achievement. It used to be said that armies "travel on their stomachs," which in modern parlance is changed to include "flying on their briefings." To get there "fust with the mostest men" is still a good rule in warfare—but what if the men who get there don't know

how to shoot, or how to face fire, or pack heavy loads, or cut barbwire fencing, or execute a skillful retreat? Those maligned old drill sergeants and their walloping ways of handing out information count for as much as numbers and ammunition when the battle begins.

Now it may sound funny, but it's true, even our staid and hard-boiled Congressmen must have information. Sometimes they do not act on it, but they want a lot of it all the time. Their best handy source of current information is the Congressional Record, one of the country's most reliable and astonishing short-hand-reported dailies. Maybe they don't read much of it, except the fine-print appendix which carries the many speeches and letters they made or received, or sent themselves. But anyhow, it's a public record, a silent but impartial and indispensable document, and a model of accurate reporting. That is, it is scientifically reported, but the speeches are not vouched for as to logic or truth by the editors and distributors of the Record. Information therefore is not necessarily truth. It tells the reader what transpired and doesn't seek to influence him by editorial comments inserted on the side.

Moreover, Congress not long since tried to set up its own inside information service, linking it alongside the legislative reference aids open to members wishing to draft bills. Here is further evidence of the reliance of public men and women on the broad and convenient information which is prepared by experts in unbiased ways, and not by casual half-time and scheming amateurs.

Nor do members of Congress stop there. They keep their staffs busy telephoning various departments of the government, mostly to secure the answers to the vast barrage of anxious queries put to them by their importunate constituents. No day passes without hundreds of scurrying employees scattered throughout the bureaus whose pressing job for the moment is to get a reply at once to the Hon. Bill Lawmaker. If the department's hasty searchers are "misinformation" men or outright phonies, Mr. Lawmaker is going to get some bum advice.

NOW this in turn brings us to point three of our information test: ***Public dependence upon sound information is the bulwark of sound and honest government.*** Lack of it causes all those costly hearings.

Few there are in or out of Congress who actually sense the fact that information gathering and handling are professional tasks. Nor is it often recognized that professional information workers of the highest caliber are folks who disdain to color or distort the events and the activities unfolding before them. But the misfits and the phonies do.

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Corn Research Results At Work in North Georgia[1]

By Orien L. Brooks

Georgia Mountain Experiment Station, Blairsville, Georgia

THE adoption of better corn-growing methods by farmers in north Georgia has resulted in the production of much higher yields in this area than the present State average of 16.5 bushels per acre. When all of the improved practices are followed, yields of 6 to 10 times the State average are being produced, often on the same, previously low-yielding soils. Boosting yields from 10-20 to 100-150 bushels per acre covers a wide gap and, necessarily, requires sound soil management and proper cropping methods.

Corn fertility studies in relation to soil types were started in the mountain area in 1946. The primary aim of these tests was to discover the major problems of soil and crop management and to help farmers correct them whenever possible. Variety and spacing tests also played an important part in the over-all effort to increase corn yields. These experiments represented the frontier of basic research with field crops in this mountain area. All of the tests were conducted on outlying experimental areas under actual farm conditions. In this way the desired types of soil and levels of fertility could be obtained.

This approach brought many people who should be interested in such tests into action; and, more important, it allowed farmer participation. This was a new experience for the cooperators and has made for a working relationship among farmers and between agencies that has made field results more meaningful. As a result of this arrangement, cooperative test methods have become field practices very rapidly.

With the careful management of some 1,500 plots annually (allowing for randomization and replication to correct for soil variation and experimental error), sound recommendations for increasing corn yields after a period of five years can easily be made: (1) Use plenty of fertilizer in the right proportion and at the right time; (2) plant an adapted hybrid; (3) leave enough plants per acre to make efficient use of the fertilizer applied and the natural fertility of the soil; (4) sidedress when plants are 35 days old; and (5) cultivate lightly and often until the corn is about 2½ feet tall, and then stop plowing.

The value of these tests will be better understood if field results are noted. Most striking of all the yields recorded were those that so forcefully showed that the application of not just one but several of the major plant-food elements is necessary to produce high yields of good quality corn.

Perhaps it is too widely believed that nitrogen and moisture are all that are needed to produce corn in Georgia. The lack of nitrogen is the most common cause of poor corn yields in the mountain section, but on some soils the lack of phosphate or potash can reduce yields just as much. Also, responses to lime were obtained in sev-

[1] Cooperative testing at Blairsville, Georgia, of the Soils and Fertilizer Research Branch, Division of Agricultural Relations, Tennessee Valley Authority; Georgia Mountain Experiment Station, the Georgia Experiment Station, the Georgia Extension Service, and various cooperating farmers.

Fig. 1. Response to complete fertilization on test area.

eral cases. On 30 different fields ranging from poor to good in fertility, lime gave an average increase of 5.3 bushels per acre. This is about one-third of the average yield per acre for the State, and enough at the current price of corn to pay the purchase and spreading costs of lime. Phosphate has given a boost of 35.4 bushels per acre on some poor soils, or 1¾ bushels of corn for each six-cent investment. On a Hayesville soil, potash increased the yield by 61.6 bushels per acre over corn grown without potash. This element is more often lacking on black, bottomland soils. The average results of four years of testing on various soils at various fertility levels have demonstrated that liberal applications of potash are economically sound.

These results are proof that the application of single elements is important in corn production only in particular situations and on individual soils. Generally, the need is for balanced amounts of all the plant-food elements just as all the required ingredients are necessary in order to produce high yields of good quality. A typical yield increase by complete fertilization is clearly proved by a recent test on a Transylvania soil. Corn was practically a complete failure on this field without fertilizer, producing only 7.5 bushels per acre. When enough fertilizer was applied, the yield jumped about 100 bushels per acre, or 14.7 times to 108.7 bushels per acre. The producer should have his soil tested to determine whether he needs one or all the plant-food elements. Soil testing is provided as a free service to all the farmers of Georgia.

Increasing corn yields, like travel to a certain point, may be approached by more than one route; and just as surely as two mules can plow a field more quickly than one, corn yields can be pushed higher by making use of more than one good practice. Adapted hybrids are outyielding open-pollinated varieties to the extent that farmers are losing money when they continue to plant the old standby. Ga. 101 and Dixie 17 have outyielded the most commonly used variety by 24 and 21 per cent, respectively.

Corn plants should be spaced according to the amount of fertilizer put down on both poor and rich soils. Yields from spacings closer than those commonly used have ranged from 8

Fig. 2. Field response to complete fertilization where potash is the greatest limiting factor. Check plot center yielded 7.5 bushels per acre. Yield on right was 108.7 bushels per acre.

to 32 per cent above those obtained from the common rates of planting.

What are farmers doing about higher corn yields per acre? Here are the returns from the effort. Even before any results were published, farmers were so well acquainted with the facts in the field that some practices became established. Three years ago we started asking for a 4-12-12 fertilizer and this was one of the first sections to obtain a fertilizer of this analysis for general use. It has proved to be a good fertilizer for pastures as well, and is being recommended even outside north Georgia. Fertilizer of this analysis is also being used on many other crops.

For average conditions these tests have shown that the best economic return can be gained and the soil left at about the same level of fertility when 500 pounds of 4-12-12 are applied at planting and adequate sidedressing is applied. The planting application places one-third of the N and all of the P_2O_5 and K_2O under the corn, while 40 pounds of N are applied as sidedressing when the corn is 35 days old, or about 2½ feet high.

On one farm that is mostly bottomland Transylvania soil, the operators stated that previous to 1947 they had never produced yields better than 40 bushels per acre on the average. A fertility, spacing, and hybrid-variety test was conducted, all the same year, on this farm. The following year, combining all of the best results from these tests, each of the five operators produced more than 100 bushels per acre on some part of his crop.

One of the first areas selected for these experiments was on a Hiawassee soil. It was estimated that the operator had produced a yield of 20 bushels per acre on the previous crop. The farmer's estimate was even lower. After cooperating in a fertility, spacing, and variety test, the same operator combined the best practices from each test in the same field. The yield, then, from one acre was 157 bushels per acre of good corn, or approximately an eightfold increase over the crop grown three years before in the same field.

During the fourth year of this corn-testing program, 194 farmers in the three counties (Towns, Union, and Fannin) in which the experiments were conducted produced 100 bushels

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Fig. 1. Japanese farmer applying night soil to area between the rows of vegetables.

Fertilizer in Japan

By E. V. Staker[1]

Chemurgy Department, University of Nebraska, Lincoln, Nebraska

FERTILIZER has played an important role in Japanese economy for centuries. It is not known when the use of commercial fertilizer began, but history records that as early as 1624 trade in fish-meal fertilizer flourished in Osaka. Authoritative Japanese sources claim that fertilizer commerce began in Japan 100 years earlier than in Europe. At first, trade was confined to organic materials. It was not until 1886, the date which marked the beginning of the superphosphate industry, that inorganic fertilizer came into use.

Agricultural conditions peculiar to Japan have resulted in fertilizer problems which are especially characteristic of that country. Soils are low in fertility. This condition stems partly from the fact that approximately 25 per cent of the arable area is derived from volcanic ash material low in fertilizer nutrients. In addition, centuries of intensive cropping have reduced the potential supply of plant-food elements in the soil to such a point that high crop yields cannot be obtained without liberal applications of fertilizer.

For many years before the outbreak of World War II, the soils of Japan were heavily fertilized in comparison with those of most other countries. Data compiled by the Ministry of Agriculture and Forestry show that with respect to commercial fertilizer consumed by the major agricultural countries of the world during 1935-1937, in pounds per acre of arable land, Japan was third in the total amount of nitrogen (37.4 lbs.), fifth in phosphoric acid (34.4 lbs.), and fifth in the amount of potash (15.1 lbs.). During the same period,

[1] Formerly Scientific Consultant, Agricultural Division, GHQ, SCAP.

Japan was the world's largest user of ammonium sulfate.

Fertilizer Requirements

On the basis of current crop acreage, the total quantity of fertilizer required for maximum economic production of all crops under present conditions is estimated to be equivalent to 2,293,000 metric tons of ammonium sulfate (20% N), 1,725,000 metric tons superphosphate (16% P_2O_5), and 607,000 metric tons of potash salts (40% K_2O). As additional land is brought under cultivation through the land reclamation program, these requirements will increase. A recent survey of farmer demand conducted by the Ministry of Agriculture and Forestry indicates that at current prices farmers would buy somewhat less than the quantities indicated above. Effective farmer demand cannot be projected accurately because of difficulties in estimating effects of prices, farmer education, etc. For planning purposes, the demand for nitrogen in US FY 51 [1] was estimated as equivalent to approximately 2,000,000 metric tons of ammonium sulfate, phosphate equivalent to 1,650,000 metric tons of superphosphate, and potash equivalent to 500,000 metric tons potash salts (40% K_2O).

Production

In 1941 the nation had ample facilities to produce most of her nitrogenous and phosphatic commercial fertilizer requirements. Phosphate rock for processing into superphosphate, however, had to be purchased from abroad; and the inorganic potash supply was entirely dependent upon imports. Indigenous deposits of phosphate rock and potash are virtually non-existent.

In 1937 Japan ranked third in world production of nitrogenous fertilizers, and sixth in the amount of phosphatic fertilizers processed. Average annual production of all three types of commercial fertilizer during the period 1936-40 was larger than during any other five-year period. Average nitrogen output (organic and inorganic forms combined) during this period was equivalent to 1,814,000 metric tons ammonium sulfate annually, superphosphate averaged 1,936,000 metric tons, and potash was equivalent to 25,000 metric tons salts (40% K_2O). More than half of the commercial potash manufactured during this period was organic material.

During World War II, Japanese fertilizer plants were badly damaged by Allied bombing raids. After the termination of hostilities, the Occupation took immediate steps to rehabilitate the fertilizer industry, and on May 17, 1946, the Supreme Commander for the Allied Powers approved the conversion of a number of nitrogen plants formerly used for munitions manufacture to the production of nitrogenous fertilizer. At that time, these plants, together with those normally supplying fertilizers, were judged capable of eventually turning out the equivalent of about 2,000,000 metric tons of inorganic nitrogen fertilizer annually.

Great progress has been made in increasing indigenous fertilizer output since 1945. The output of inorganic nitrogen materials in US FY 50 was equivalent to 1,816,602 metric tons ammonium sulfate, slightly larger than the prewar (1936-40) average production of organic and inorganic nitrogenous fertilizer combined. It is expected that production equal to the 1946 2,000,000-ton capacity estimate will be achieved in US FY 51.

Production of superphosphate fertilizer from imported phosphate rock also has increased rapidly since 1945 and will nearly equal estimated crop requirements for US FY 51. Potash supplies from domestic sources will continue to be of no commercial importance.

Fertilizer production in Japan for fiscal years 1946-50 inclusive and estimated output in fiscal year 1951 are shown in Table I. The figures do not include relatively small quantities of

[1] The United States fiscal year begins July 1 and ends June 30.

nitrogen, phosphorus, and potassium derived from organic fertilizers, reliable data for which are not available.

Imports

To help meet the pressing need for fertilizer to increase food production, the Occupation instituted an import program. Imports of fertilizer and phosphate rock into Japan during U. S. fiscal years 1946-50 are shown in Table II.

Though the data for nitrogen in Table II are expressed as equivalent to ammonium sulfate, all nitrogen imports until late in FY 50 were in the form of ammonium nitrate procured from U. S. Government-owned ordnance plants in the United States. During the closing months of FY 50, substantial tonnages of ammonium sulfate were imported.

Consumption

The combined effect of the import and indigenous production programs sponsored by the Occupation has been a steadily increasing supply of commercial fertilizer to farmers. Annual con-

TABLE I.—PRODUCTION OF INORGANIC COMMERCIAL FERTILIZER IN JAPAN [1]

(metric tons)

	Nitrogenous	Phosphatic	Potassic
US FY 46..	345,251	190,141	Negligible
US FY 47..	811,914	455,616	Negligible
US FY 48..	993,428	871,799	Negligible
US FY 49..	1,371,663	1,041,977	Negligible
US FY 50..	1,816,602	1,463,642	Negligible
US FY 51 [2].	2,000,000	1,562,000	Negligible

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N) and phosphatic as superphosphate (16% P_2O_5). Source: Industry Division, Economic and Scientific Section, GHQ, SCAP.

[2] Tonnages for FY 51 are estimates.

TABLE II.—IMPORTS OF COMMERCIAL FERTILIZER AND PHOSPHATE ROCK INTO JAPAN [1]

(metric tons)

	Nitrogenous Fertilizer	Potash Fertilizer	Phosphate Rock
US FY 46..	0	0	10,895
US FY 47..	118,552	112,536	782,018
US FY 48..	481,965	8,391	630,305
US FY 49..	363,471	255,473	238,293
US FY 50..	464,580	243,054	757,368

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N), potash fertilizer as potash salts (40% K_2O), and phosphate rock as 32% P_2O_5.

Fig. 2. Farmers near Tokyo applying fertilizer in rows before planting fall wheat. The man and woman on the left are adding a mixture of compost and superphosphate. This is covered with a shallow layer of soil upon which the man at the right distributes a mixture of ammonium nitrate and potassium chloride. Soil is again spread over the row after which the seed is sown.

Fig. 3. Japanese at work on fertilizer experiment using white potatoes as the test crop. Picture taken in May 1950, Hokkaido Agricultural Experiment Station, Sapporo, Japan.

sumption by Japanese agriculture for fiscal years 1946-50, inclusive, is shown in Table III.

The aggregate consumption of all fertilizer nutrients from inorganic sources in FY 50 was equal to 113 per cent of the 1931-40 average annual usage and 91 per cent of the 1936-40 average annual usage. In addition, the Ministry of Agriculture and Forestry estimated that organic fertilizer equivalent to 132,000 metric tons of ammonium sulfate, 63,931 metric tons of superphosphate, and 14,000 metric tons of potash salts, respectively, were consumed.

TABLE III.—CONSUMPTION OF INORGANIC COMMERCIAL FERTILIZER IN JAPAN [1]

(metric tons)

	Nitrogenous (20% N)	Phosphatic (16% P_2O_5)	Potassic (40% K_2O)
US FY 46..	452,142	32,156	8,805
US FY 47..	842,992	348,616	100,000
US FY 48..	1,462,324	705,483	15,000
US FY 49..	1,731,090	1,034,977	154,000
US FY 50..	1,750,057	1,185,139	205,498

[1] Consumption includes fertilizer used by crops, that used by government institutions, and quantities awarded to farmers as incentive goods.

Exports

Exports of commercial fertilizer from Japan during the period 1936-40 averaged the equivalent of 217,000 metric tons of ammonium sulfate and 232,000 metric tons of superphosphate annually. Potash exports were negligible. During World War II exports were insignificant except for nitrogen in 1942 and 1943 when the equivalent of 120,000 and 148,000 metric tons, respectively, of ammonium sulfate were sold abroad. Since Japan's indigenous production of commercial fertilizer during the postwar period has been drastically short of the quantities needed to maximize agricultural production in the country, Natural Resources Section, GHQ, SCAP did not authorize the export of fertilizer except for relatively small shipments to Korea and the Ryukyus. Tonnages of commercial fertilizer exported since the termination of hostilities of World War II are shown in Table IV.

Supplies of ammonium sulfate available for export in US FY 51 will be considerably larger than in any previous postwar year. Production probably will not exceed domestic requirements but carry-over from the previous year

TABLE IV.—EXPORTS OF COMMERCIAL FERTILIZER FROM JAPAN[1]

(metric tons)

	Nitrogenous	Phosphatic	Potassic
US FY 46..	0	0	0
US FY 47..	3,597	48,081	0
US FY 48..	29,354	116,554	0
US FY 49..	627	21,675	0
US FY 50..	3,782	2,915	737

[1] Nitrogenous fertilizer expressed as equivalent to ammonium sulfate (20% N), phosphatic as superphosphate (16% P_2O_5), and potassic as potash salts (40% K_2O).

will exceed materially the normal carry-over requirement. This relatively large carry-over (equivalent to approximately 455,000 metric tons of ammonium sulfate) resulted from production rates during the spring of 1950 which far exceeded expectations and which were made possible chiefly by increased availability of hydroelectric power resulting from abnormally heavy rainfall.

Allocations

The necessity for a fertilizer allocation system, as an aid to achieving efficient use of diminishing fertilizer supplies, became evident to the Japanese government during World War II. Such a system was first established through the Nogyokai or Agricultural Association. In the fall of 1944, however, the responsibility for allocating fertilizer to farmers was taken over by the Ministry of Agriculture and Forestry.

Improvement of the fertilizer allocation system was one of the first problems receiving attention by Occupation Forces. Close cooperation between fertilizer specialists in the Agriculture Division of Natural Resources Section, personnel in other sections of General Headquarters, Supreme Commander for the Allied Powers, and officials of the Japanese government brought about a satisfactory solution of most phases of the problem. One of the important results of this collaboration was more efficient allocation of the limited supplies as between various crops, on the basis of individual crop requirements. Farmer interest in allocations also was stimulated. Farmers learned to insist on fair allocation practices, especially at the village level.

The organization of the Fertilizer Distribution Kodan (Fertilizer Distribution Corporation) as a government-

Fig. 4. Preparing fertilizer plots for the transplanting of rice. Note concrete frames used. Tohoku Agricultural Experiment Station, Omagari, Japan, June 1950.

owned corporation in 1947 facilitated fertilizer distribution. This organization received domestically produced nitrogenous and phosphatic fertilizer at the factory and distributed it to prefecture, city, town, and village warehouses in accordance with the allocation plan prepared by the Ministry of Agriculture and Forestry. The Fertilizer Kodan also had the responsibility for distributing imported nitrogenous and potassic fertilizer on a similar basis.

From the closing years of World War II to the end of 1949, quantities of commercial fertilizer used by farmers were limited principally by available supplies. As a measure to minimize inflation of food crop prices and to maximize food production without placing undue burden on the farm economy, the prices which farmers paid for fertilizer were controlled by the government at a level which generally did not limit farmer purchases. Domestic production and imports of fertilizer were subsidized by the government to make up the difference between actual costs and prices paid by farmers.

With total fertilizer supplies during US FY 50 approaching the 1936-40 average level of usage and 1949 staple food crop production exceeding the 1936-40 level, SCAP and Japanese government officials believed that elimination of subsidies and controls should be initiated. This was effected on August 1, 1950, except for a government import subsidy on phosphate rock. At the same time the business of the Fertilizer Distribution Kodan was limited to liquidation sales.

Since that date all sales and shipments of fertilizer including exports have been on a free market. In the case of exports, however, the Japanese Government requires export licenses to prevent a reduction of indigenous supplies to a point below demand for the various items.

The effect of decontrol on retail fertilizer prices has not been particularly unfavorable. The price to the farmer on December 1, 1950, of ammonium sulfate (20% N) and superphosphate (16% P_2O_5) was slightly lower than on August 1 the same year. On the other hand the cost of sulfate of potash increased 35 per cent and muriate of potash about 8 per cent.

Use of Organic Materials

The importance of maximizing the use of such materials as compost, animal manures, and night soil in crop production has been emphasized by the Japanese government for many years. It is estimated that during the five-year period, 1936-40, the percentages of the total quantities of fertilizer nutrients supplied by farm manures were: nitrogen, 48 per cent; phosphoric acid (P_2O_5), 35 per cent; and potash (K_2O), 74 per cent. The current use of compost and night soil is estimated to be above the 1936-40 average.

Work of the Agricultural Division, GHQ, SCAP

The Agriculture Division has advised and guided Japanese government officials in planning and carrying out many phases of the over-all fertilizer program. Assistance has been given in the determination of import needs and timely allocations to the various crops. Research work on fertilizers has been actively promoted.

As a result of Agricultural Division advice and guidance, Japanese technicians established in 1950 a number of field plot experiments to determine the fertilizer requirements of the staple food crops. While considerable data were already available from fertilizer tests made in past years, it was impossible in most cases to arrive at any definite conclusions. This was largely because of inadequate plot layouts.

Experiments begun in the spring of 1950 were limited to potatoes, sweet potatoes, and rice. The tests were as well distributed geographically as climatic requirements for the crops would permit. A randomized block design was used which made it possible to de-

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Fig. 1. Whitehall Farm cows are getting their fifth feeding off this ladino pasture this season. Photo was taken September 4. Corey home is in background. Mr. Corey confines cattle while grazing by electric fence so that the cows are concentrated in a given area rather than allowed to meander over the whole pasture.

M. V. Corey, Middletown, R. I. 1951 N. E. Grassland Winner

By H. M. Hofford

University of Rhode Island, Kingston, Rhode Island

THE money he spends for fertilizer is the best investment Manuel V. Corey of Middletown, R. I., makes in his annual farming operation. Winner of the 1951 New England Green Pastures Contest, Mr. Corey says his program of split application of fertilizer to his fields is in his opinion a major factor in the outstanding success of his grassland farming.

On his Whitehall Farm—so named because on it is located the 222-year-old farmhouse called "Whitehall" that was built in 1729 by Dean George Berkeley, famed British philosopher—comprising some 84 acres, the backbone of his feeding program is ladino clover for pasture, and alfalfa and red clover in combination with grasses for second and third cutting hay. He has been milking 45 cows on a one to six grain to milk ratio.

Mr. Corey has been using a 5-10-10 fertilizer for seeding down and 600 to 800 pounds of 0-20-20 fertilizer per acre for topdressing, applying it in both the spring and the fall on some pastures, and about 400 pounds at each season on others. Besides, he adds a light coat of manure and superphosphate daily during the winter from the barn.

The Corey herd goes out to pasture about the middle of April and stays up to November. Some of the fields yield from four to six feedings.

Farmer Corey attributes some of the

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Fig. 1. While Miss Lorene Horner, Laboratory Technician, is making soil tests, Marcus Holman, County Agent for Douglas County, explains to visiting farmers the setup and operation of their county soil-testing laboratory.

Fertilizer Recommendations Based on Soil Tests

By O. T. Coleman

Soils Department, University of Missouri, Columbia, Missouri

BY integrating fertilizer recommendations with soil tests, we have been able to materially reduce the risk in production and the resulting net returns by fertilizing the soil so that plant food will be eliminated as the limiting factor in plant growth. Soil tests made possible more intelligent deep applications of the plant foods needed to bring up the level of fertility to an adequate reserve supply of the different nutrients in proper balance for maximum production of quality crops. When this is done, and this level is maintained through the use of starter or maintenance applications, the calculated risk is reduced to such other factors as unadapted varieties, poor drainage, lack of or excess moisture, improper planting and cultural practices, and disease or insect damage, or a combination of these. Usually, however, when plant foods are ample and in proper balance in the zone of the feeder roots during the growing season, there is a material reduction in the calculated risk resulting from the detrimental effects of these other limiting factors.

Considerations which should receive major attention in reducing this calculated risk to the minimum when integrating fertilizer recommendations with soil tests are:

1. The exchange capacity of the soil.
2. The species of plant and the root

surface in contact with the soil.
3. The amounts of the various plant foods that will be released from the soil during the growing season—as indicated by soil tests.
4. The nature and condition of the soil treatments applied, the soil to which they are applied, and when and how they are applied.

In our 72 county soil-testing laboratories, all financed locally, tests are made for per cent organic matter, soluble phosphate, exchangeable potash, calcium, magnesium, and soil acidity, or pH. Twenty-six of these laboratories are now measuring the pH and total hydrogen with a limemeter, developed by C. M. Woodruff of the Department of Soils. The remaining 46 laboratories use the Comber test for determining soil acidity. The phosphate and potash tests used were developed by Dr. R. H. Bray of Illinois, while the organic matter and the exchangeable calcium and magnesium tests were developed by Dr. E. R. Graham of the Department of Soils, University of Missouri.

Our first three county laboratories were established in 1946. The following table shows the number in the State the last three years, the total number of tests made, the number made per laboratory, and the number of farmers taking advantage of this service.

Year	Number of county labs.	Number of samples tested	Av. number tests/ lab.	Number farmers having tests made
1948.	46	24,331	529	12,577
1949.	60	45,369	756	19,614
1950.	69	67,648	980	29,080

In 1951 there have been three additional county laboratories set up.

Largely as a result of this testing program, fertilizer recommendations made more on the basis of pounds of plant food than pounds of fertilizer are now worked out with the farmer. Because of this, combined with our policy of thinking with the farmer rather than for him, and the cooperation given by our farm organizations and fertilizer dealers in making higher analysis goods available, the average per cent of plant food in mixed fertilizers sold in Missouri has increased from 21% in 1946 to 27.4% for the last six months of 1950. In the materials and mixed goods used, the total tons of nitrogen has increased from 4,665 to 21,865, the tons of potash from 9,964 to 26,047, and rock phosphate used from 3,954 tons to 116,451 between 1946, when our first three county soil-testing laboratories were set up, and 1950. During this same period the total tons of plant foods in all processed goods has increased from 45,677 to 100,547.

Since the exchange capacity of the soils in Missouri vary from less than 5 milliequivalents per 100 grams of soil on the sandy southeast Missouri lowlands and the highly leached Ozark uplands to about 30 milliequivalents on our heavy Wabash clay bottom soils high in organic matter, consideration must be given this factor in determining the release of plant foods and the level to which the mineral supply should be built up. Fortunately, however, most of our soils have a relatively high content of montmorillonite, or swelling clays, which serve as a storehouse for plant nutrients. The high exchange capacity of this type of clay makes it possible to build back plant-food reserves that have been exhausted by excessive cropping. The exchangeable nutrients, namely, potassium, calcium, magnesium, and the adsorbed phosphorus ion, are relatively immobile, hence move through this kind of soil quite slowly. When applying these nutrients, they should be placed well into the soil so as to be in the zone of the plant roots in order that they may be most effectively used. Since they do not leach readily out of such soils, they can safely be applied in sufficient quantities to restore deficiencies and meet the major plant-food needs for several years, especially

when proper starter or maintenance applications are used.

Because of the relative immobility of these mineral nutrients, their availability to plants is largely dependent upon the extent to which their root surface is in contact with the soil. It has been shown by Dittmer[1] that the soybean has only 2.5 square inches of root surface in contact with a cubic inch of soil; the oat plant, 13.9 square inches; and the rye plant, 30 square inches. This variation in root surface in contact with the soil explains why a higher level of fertility is needed for satisfactory production of soybeans and similar crops than for rye which has a more extensive root contact with the soil. Since such plants as clovers and alfalfa have the ability to synthesize a high protein content in their tissues, they will naturally have a higher requirement for mineral nutrients than do the more carbonaceous non-legumes. Because of this, the higher protein crops grow satisfactorily only on soils with a high mineral content, while a crop such as rye which has rather an extensive feeder root system and is lower in protein does not require as high a level of mineral nutrients to make its yield of greater carbohydrate and cellulose content.

The fact that poor soil is able to release a sufficient amount of plant food for a fair crop in a favorable growing season has been responsible for the erroneous and rather widespread belief that weather is responsible for good or poor crops. Soils with a high reserve of soil fertility are able to release sufficient nutrients for a fair crop even in unfavorable growing seasons. This explains why in unfavorable growing seasons, crops on poor soils fail chiefly because of insufficient fertility. Our Missouri River bottom soils, with their high stock of reserve minerals, produce a fair crop of the protein-rich soybeans in unfavorable growing seasons, while on our depleted prairie uplands, they will be almost a failure but will produce a fair crop in good growing seasons.

Unlike mineral nutrients, nitrates are mobile and are carried down into the soil by percolating water. Because of this, nitrates cannot be stored as such in the soil and do not lend themselves so well to measure by soil tests. The amount of this nutrient present in the soil varies with bacterial activity, which in turn is affected by soil tilth, drainage, aeration, the amount and kind of organic matter, soil texture, etc. Nitrogen, however, is held in the soil in a rather stable form as organic matter or humus. A much better estimate of the nitrogen that will be released during the growing season can, therefore, be made by testing the soil for its per cent of stable organic matter.

As this organic matter decomposes, it produces the mobile nitrates which diffuse readily through the soil with the percolating soil water to the roots, and as a result they are approximately 100% available. Since under average Missouri conditions about 5% of this organic matter is nitrogen, one can readily determine from the per cent of stable organic matter in the surface 7 inches of soil how much of this plant nutrient is present. Under Missouri soil and climatic conditions, it has been found that from 4 to 6% of the total nitrogen present in stable organic matter is released annually from the sands and sandy loam soils, from 2 to 3% from the silt and silt loam soils, and about 1¼ to 2½% from the clay and clay loam soils. For example, if a soil showed 2% stable organic matter, this would mean that 2% of the surface 7 inches, or the 2,000,000 pounds of soil, would contain 40,000 pounds of stable organic matter. Considering that an average of 5% of this organic matter is nitrogen, this would be 2,000 pounds of this nutrient in the surface 7 inches of soil. If this was a poorly drained, poorly aerated silt loam soil with a relatively high lime requirement and had been poorly handled and cropped,

[1] Dittmer, H. J., *A Quantitative Study of the Subterranean Member of the Soybean.* Soil Conservation, Vol. 6, 1940, pp. 33-34.

Fig. 2. This field was treated according to soil test recommendations and the stand increased to better utilize this added fertility. Experiments and field demonstrations have strongly indicated that weeds are much easier to control and less cultivation is necessary under these conditions.

the minimum of about 2% or approximately 40 pounds of this nitrogen would be released during the average growing season. If this soil was well drained and well aerated and contained a fair supply of minerals, one could expect a nitrogen release of approximately 3% or 60 pounds during the growing season. Since it requires from 1½ to 2 pounds of this nitrogen to produce a bushel of corn, this would mean that on the poorly drained and poorly aerated silt loam soil having a test of 2% organic matter, enough nitrogen would be released for the production of 20 or 26 bushels of corn

Fig. 3. This field was the same type of soil as that in Fig. 2 but was farmed according to outmoded methods of corn production. Note the weeds and grass growing in the corn.

during the average growing season. On the other hand, on a well-drained and well-aerated silt loam soil testing 2% organic matter, one could expect a yield of between 30 and 40 bushels per acre.

Our experiments and demonstrations have shown that we can bring our yield of corn up 60 or 70 bushels by growing legumes in the rotation, but to attain higher yields it is usually necessary to supplement the nitrogen added by legumes with commercial nitrogen. These tests have shown that where mineral plant nutrients are sufficient, chemical nitrogen applications up to 80 pounds per acre can be expected to give an increase of one bushel of corn for each two to three pounds of nitrogen applied, and boost the protein content as much as one-fourth. For example, take an average silt loam soil that tested 3% organic matter, there would be a release of approximately 75 pounds of nitrogen, or enough for 38 to 50 bushels of corn (an average of about 45 bushels) during the average growing season. Now if one wished to grow 100 bushels per acre on this field and had a sweet clover crop growing on it that would furnish about two tons (air-dry basis) of green manure per acre, we would make our calculations as follows. The 55 bushels added yield of corn desired (100—45) would require about 130 pounds of extra nitrogen. Allowing 30 pounds per ton for the air-dry sweet clover turned under, or a total of 60 pounds, this should increase the yield by about 25 bushels or up to about 70 bushels per acre. The nitrogen for the additional 30 bushels, about 75 pounds, would then need to be furnished as fertilizer in order to bring the yield per acre up to 100 bushels.

On wheat, applications up to 40 pounds per acre have given a bushel increase for each 3 pounds of nitrogen applied, while with oats a bushel increase has been received for each 1½ pounds of nitrogen added. Grass seed and hay yields have been doubled with applications of 40 to 80 pounds of nitrogen, and the protein content increased where the mineral levels were satisfactory. From 8 to 10 pounds of grass seed have been obtained from each pound of nitrogen applied up to 80 pounds per acre, and frequently even more than this on our heavier soils. Before legumes can fix nitrogen from the atmosphere they must have some top and root growth. Chemical nitrogen on our low organic matter soils helps legumes to a quicker start, enabling them to fix atmospheric nitrogen earlier. This results in the establishment of thicker, more vigorous growing stands of both legumes and grasses, and a heavier sod, thus giving greater livestock carrying capacity and greater effectiveness against erosion.

Chemical nitrogen has also been used quite effectively in experiments at Columbia to narrow the carbon nitrogen ratio of straw, corn stalks, cotton hulls, corn cobs, and other carbonaceous material applied to the soil. In 1950, 20 tons of straw per acre plus 800 pounds nitrogen yielded 118 bushels of corn and 90 bushels of oats; 20 tons of corn stalks plus 800 pounds nitrogen gave yields of 120 bushels of corn and 82 bushels of oats. These tests have indicated that nitrogen used to supplement these by-products may help reduce the extent of their destruction and the resulting loss of organic matter by burning. This should encourage the return of these highly carbonaceous materials to the soil, thereby increasing the soil organic matter content, with the resulting increased intake of water and the reduction of soil erosion.

Because of the low phosphate content of the rock or parent material from which most of our Missouri soils were derived and because of the failure to replace the phosphate removed by crops and the sale of livestock products, there is a rather widespread deficiency of this important nutrient in the soils of our State. On many of our soils this deficiency has become so pronounced

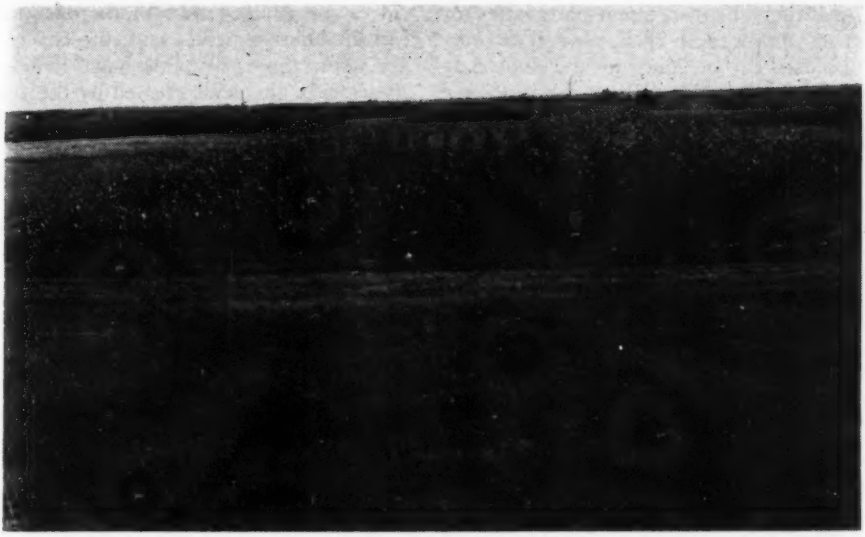

Fig. 4. The corn above shows the effects of potash removal and its restoration after 14 years of double cropping with barley and soybeans where, in each case, the whole crop was removed. All plots had 100 lbs. of nitrogen turned under ahead of this 1950 corn crop and were limed according to soil test recommendations. In addition the plot on the right had enough potash added in 1950 to bring it up to 280 lbs. The annual applications of fertilizer on each plot and the average yields of barley and soybeans the past 14 years and yield of corn in 1950 were as follows:

Plot	*Annual soil treatments*	*14-year average yields*		*1950 yields*
		Barley	*Soybeans*	*Corn*
Left	None	7.5 Bu/A	2280#/A	67.0 Bu.
Center	150# 0-20-0	13.2 "	2500 "	48.5 "
Right	" 0-20-0	15.8 "	2830 "	118.5 "

that the growth and production of protein and mineral rich crops, such as legumes and grains, are seriously handicapped. The crop yields are often low and their quality poor, even though other nutrients may be present in adequate amounts for proper growth. On the other hand, where the phosphate content is at a high level and the other plant nutrients are adequate and in balance, high acre yields of high quality mineral and protein rich forages and phosphate rich grains can be produced.

Because of the relative immobility of phosphate and its inability to move through the soil to any appreciable extent, a much higher level of this nutrient than is used by the crop must be present in the soil. The amount of this nutrient that the plant can get from the soil depends largely upon the extent of its feeder root surface in contact with the soil itself. Since legume plants are heavy feeders on phosphate and have a relatively limited root surface, a comparatively high level of phosphate must be attained for their optimum growth and yield. The sorghum plant, however, having a rather extensive root system, can obtain enough phosphate even on phosphate-deficient soil to produce considerable bulk relatively low in proteins and minerals. On our higher exchange capacity silt loam soils, indications are that the phophate level necessary to remove this nutrient as a limiting factor for optimum growth of general farm crops should be at least 200 pounds per acre plow depth. For deep-rooted crops like alfalfa the 7 to 14 inches depth should also have a like amount of phosphate. In correcting the phosphate deficiencies on a phosphate-deficient soil, adequate amounts should be applied so the tiny root hairs can obtain a sufficient amount regardless of the zone in which they may be located.

Either the processed phosphates or the unprocessed rock phosphate may be used for bringing up the phosphate level in the soil. Where the processed phosphates are used they may be applied either as split applications or as a total application. In case the split application procedure is followed, sufficient processed goods should be applied to bring the phosphate level up to at least 100 pounds with the first application, or at least halfway up to the 200-pound level, and the next time the ground is plowed, preferably a year or two later, the remainder applied. With the total, or one application method, the level should be brought up to at least 200 pounds. When processed phosphates are used to bring up this level, we figure the reserve supply will be maintained when the ordinary applications of starters are made for a period of 3-5 years. When adequate starter applications are made, this period may be materially extended.

On the low phosphate higher exchange capacity silt and clay loam soils, which are quite prevalent in Missouri, rock phosphate can be used quite satisfactorily to raise the phosphate level or build up phosphate reserves in the soil. This is especially true in cropping systems which include clovers and alfalfa, and in pastures and meadows with legume and grass mixtures. The recommended applications of rock phosphate, on the basis of soil tests, are designed to bring up this level of reserve phosphate—when the usual starter applications are made—for a period of 8 to 10 years. Except with permanent pasture or alfalfa, where no starter or maintenance applications are usually made only at the time of seeding, a soil test at this time may indicate another heavy reserve application of rock phosphate may not be advisable. Where clovers or alfalfa are used in rotation with non-legume crops, their residues supply a turnover of additional organic phosphate for the other crops.

Even when these soils are limed to meet the calcium requirements of clover and alfalfa (pH 6.5), there is still considerable mineral acid present to act upon the rock phosphate. With these acids, the acids created by the action of soil micro-organisms in breaking down the organic matter and the release of hydrogen from the legume plant roots, rock phosphate is made available in sufficient amounts to meet the needs of clovers, alfalfa, and soybeans. The non-legumes can use rock phosphates directly to a lesser extent than can the above-named legumes. When plowed down it is quite important, however, to use starter applications high in phosphate, especially if legumes have not been grown on the land since its application.

Where phosphate fertilizers are worked well into the soil, experimental and demonstrational evidence has shown one can expect much deeper and a more extensive root system from the legume crops seeded on the land. One advantage of rock phosphate is that it can be applied most any time one can get over the field. At the next working of the soil it can then be plowed under or cut in as deeply as possible with a disc or field cultivator. Where rocks, stumps, or other hazards prevent the placement of the rock phosphate into the soil, beneficial results may be expected from its application on the surface, but to a lesser degree than where it is placed well into the soil.

Potash being a relatively immobile mineral nutrient, the basic application on low-potash soils should also be worked in deeply by plowing under or cutting in with a disc or field cultivator to raise the level, in much the same way as with phosphate. Bray [2] has shown that the roots of the corn plant can contact only about 20% of the immobile, yet exchangeable, potash in the surface 7 inches of soil. From this we can readily understand why a 100

[2] Bray, Roger H., *Correlation of Soil Tests With Crop Response to Added Fertilizer Requirements, Diagnostic Techniques for Soils and Crops.*

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Concerning "Bio-dynamic Farming" and "Organic Gardening"

By Selman A. Waksman

New Jersey Agricultural Experiment Station, New Brunswick, New Jersey

THE ideas presented in recent publications on so-called "bio-dynamic," "organic," and similar methods of farming are a peculiar mixture of the real and the unreal, of fact and fancy, of good common sense and the supernatural. If soil treatment and crop production are to be based on dogmas or religious ideologies rather than on scientific principles, one need not argue further. One may then accept the thesis that "the farm is connected with the spiritual universe by the power of the thoughts of its leader." If, however, crop production is to be based on scientific facts, then such statements must be subjected to careful analysis and interpretation.

Continuous use of mineral fertilizers on the same soil for many years, without the use of organic manures or growth of sod crops to replace the organic matter lost by clean cultivation, may lead to deterioration of the physical condition of the soil and loss of productivity. This is well known by every intelligent farmer. Federal and State soil conservation agencies are placing particular emphasis on the use of soil-conserving crops.

It is being argued that use of mineral fertilizers unfavorably influences the chemical composition of plants and their nutritive properties for human and animal consumption. There is accumulating evidence, however, that plants grown in soil enriched with inorganic fertilizers, or in sand supplied with a balanced nutrient solution, including ammonium salts, nitrates, phosphates, potassium salts, and the necessary rare elements, differ very little, either in chemical composition or in nutritive properties, from plants grown in natural soil receiving only stable manures or composts.

In some "organic farming" publications, a mystical attitude is assumed toward plant growth, namely, "The will to grow." This suggests controlled selectivity of root systems of plants. Given an opportunity, however, plants will absorb not only useful elements but injurious ones as well, of which selenium is a good example. Some of these faddists speak of plants as effecting the decomposition of the soil. They mean that certain plants, such as legumes, are more readily decomposed in soil by fungi and bacteria than other plants, such as cereals. It is the plants that decompose, not the soil. The rate of decomposition of the plants and the nature of the resulting products depend entirely on their chemical composition, as determined by their nature, stage of growth, and manner of nutrition. Thus all plants decompose much more readily in the young stages of growth than in the mature stages.

Confusion

Numerous facts are misinterpreted in these "organic" and "bio-dynamic" publications and there is much evidence of confusion. For instance, the radioactive action of certain elements, a fact not well established as far as its significance in plant growth is concerned, is said to exert specific effects on both plants and the animals that consume them. The use of arsenic in insecti-

cides, a practice which aids greatly in man's fight against the ravaging insect world, leads to statements implying that fruit thus treated is highly dangerous to man.

Scientific methods are discredited by these non-scientists, as shown by the following quotations: "Although the farmer was told by the use of scientific methods in agriculture he could double the yield of his farm, the fact remains that after years of scientific help, present century farmers are discovering that their 'double' yields today are no better than the single yields of previous times." "Earth and plants have become more sensitive and erratic." "Those who treat the soil with a 'pulverizer,' destroy the real creators of natural humus, the *earthworms.*" The Chinese farmer is idolized for the very reason that we tend to condole him, as shown by the following quotation: "Mineral fertilizing is still unknown here—fortunately for the Chinese. The oldest cultural methods of humanity—*humus conservation* and *manual labor.*" The author of the above publication might well have added that *man thus became the slave of the land.*

Although "the quality and amount of the humus determine the fertility of the soil," the organic-gardeners fall immediately into a trap by assuming that only the colloidal humus, which is about 40 per cent of the total soil organic matter, is the active agent of fertility. They confuse conditions of humus formation in peat bogs with those in mineral and well-aerated soils. This is illustrated by the statement, "In humus the essential factor is its condition." This is true, but only to a certain extent. The process of decomposition of plant and animal residues leading to humus formation is highly important in making the soil fertile, since the continuous stream of carbon dioxide, ammonia and nitrate, and phosphate, resulting from such decomposition is highly important for continuous plant growth.

Mystical concepts are interwoven with facts. Frequently, advice that seeding be done in relation to the moon is given in such publications. Sunspots are credited with effects on insect pests, and mysterious forces are said to govern plant growth. Such expressions as "sun-force" and "nature-soil" are commonly employed in some of these publications.

The following statement copied from one such publication indicates the type of thinking that is involved: "A half-rotten substance makes the soil sour. But if I get a humus-like substance into the soil as fertilizer, the soil is excited to develop bacteria and other life, such as earthworms, which produce the humus in the soil, and this substance can be taken up very quickly by the plant. When organic manures rot in the ordinary way there arises amongst other things a poisonous smell as the product of albumen. Such substances are not usually changed very much, and succeed in being taken up again into the plant through the soil. If such deleterious products succeed in reaching the stream of sap in the plant, they cause disturbances which in part may be responsible for the plant sicknesses, or it is made attractive to many harmful insects."

Other Examples

Other examples of such thinking are: "Fertilizers now used in agriculture kill the vitality of the soil." "The vitality of the soil determines the vitality of the vegetation and all that exists on its surface." "Corn . . . treated by the bio-dynamic method . . . has a phosphorescent gleam which bespeaks life, compared with the latter (receiving mineral fertilizers), which, in its color, resembles zinc." "The process of nitrogen-fixation by bacteria is well known. May it not be possible that a similar process exists in the case of phosphoric acid? This is a question which deserves investigation and research." "Soils intensively treated with chemical fertilizer or orchards

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Improving Pastures In Arkansas

By Edgar A. Hodson

Soil Conservation Service, Little Rock, Arkansas

NOT many years ago improved pastures were thought to be of uncertain economic value in Arkansas (and the whole South for that matter). There actually were very few really good pastures in Arkansas. Today's picture is different. It has been proved that good pastures can be developed and that the returns in livestock gains will pay good dividends on investment in land preparation, in fertilizer, and in management.

The change is founded on conservation farming. Each time a conservation farm plan was developed for land in the upland sections of the State it was found that from 40 to 75 per cent of the open land was best suited to permanent vegetation. It was too steep, the soil too thin or too badly eroded for cultivation. That meant permanent pastures and meadows.

Proper land use as it is practiced in soil conservation districts has opened up a vast new empire of agricultural land, a new frontier that, because of the long grazing season and favorable growing conditions, is attracting large numbers of livestock producers to Arkansas after seeing what conservation farming has accomplished.

It must not be overlooked that the development of an adequate pasture program requires:

1. A sound pasture plan. The plan should provide for the several types of pasture needed for seasonal grazing. It will include permanent pasture for summer grazing, and separate supplementary summer pasture. It will provide permanent pasture for winter grazing in addition to supplementary winter pasture crops. And there must be a reserve supply of hay and silage.

2. Fertilizers and lime. Almost all Arkansas soils require lime, and because the fertility level of the soils going into pasture will on the average be low, adequate fertilizer must be used. The kinds and amount must be determined by chemical analysis or, if analysis is not available, by the best local experience. Fertilizer experiments have shown that each dollar spent for fertilizer returns an average of about seven dollars in livestock gains.

3. Good land preparation. Brush must be removed, sage grass destroyed. The land must be left in a condition to permit mowing.

4. Grasses and legumes best suited to the soils. A crop can be chosen for deep well-drained soils, for poorly drained land, for good upland soil, or shallow upland soil. Choosing the crop best suited to the soil is of vast importance.

5. Good management. This includes all of the things needed to keep the pasture producing the highest possible yield of palatable, nutritious forage. It includes mowing, the application of minerals when needed, controlled grazing, a good water supply, renovation and the maintenance of a good stand of a base grass with a suitable companion legume.

Soil conservation district cooperators are developing year-round grazing programs that are furnishing good grazing all of the year except for periods of

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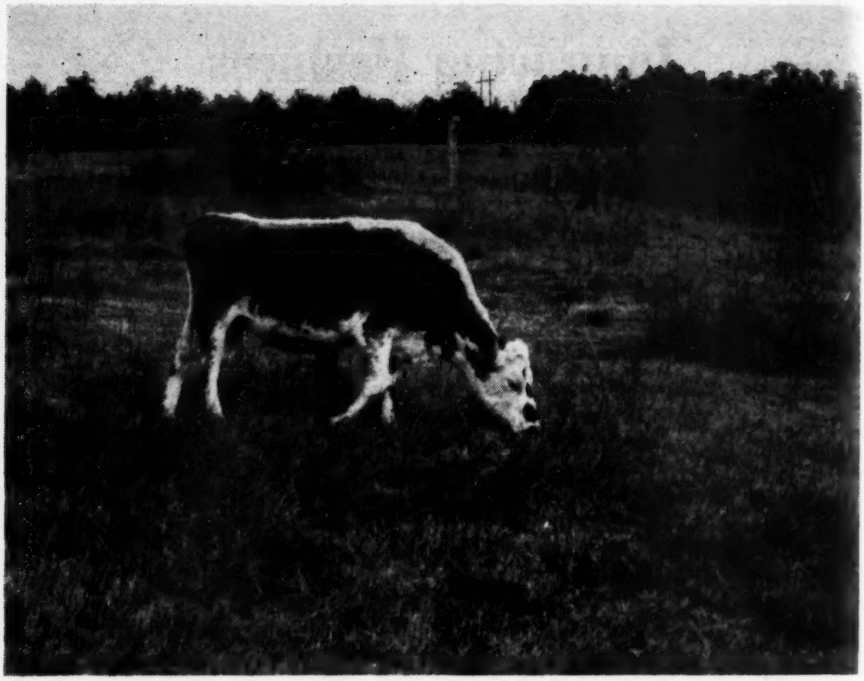
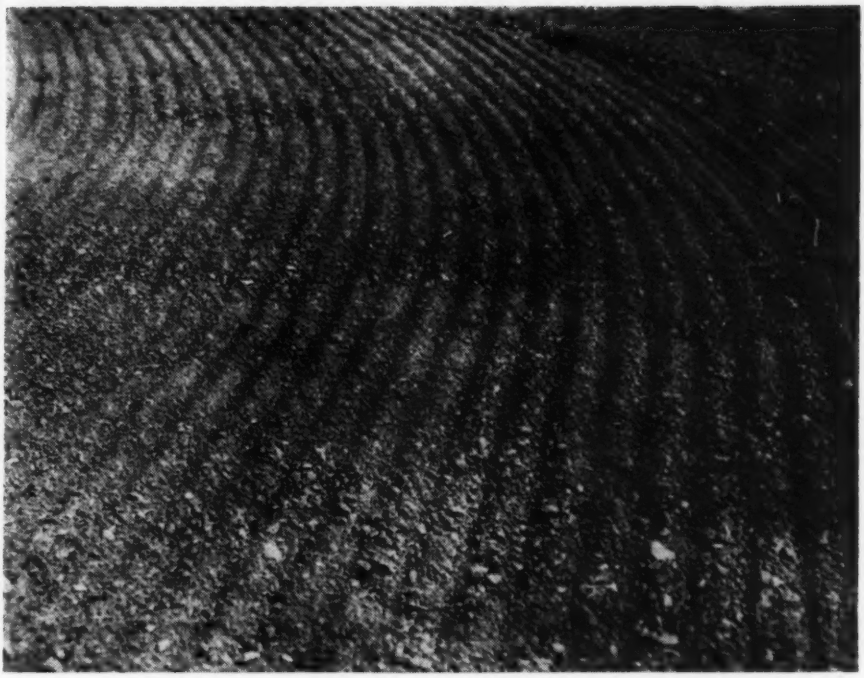


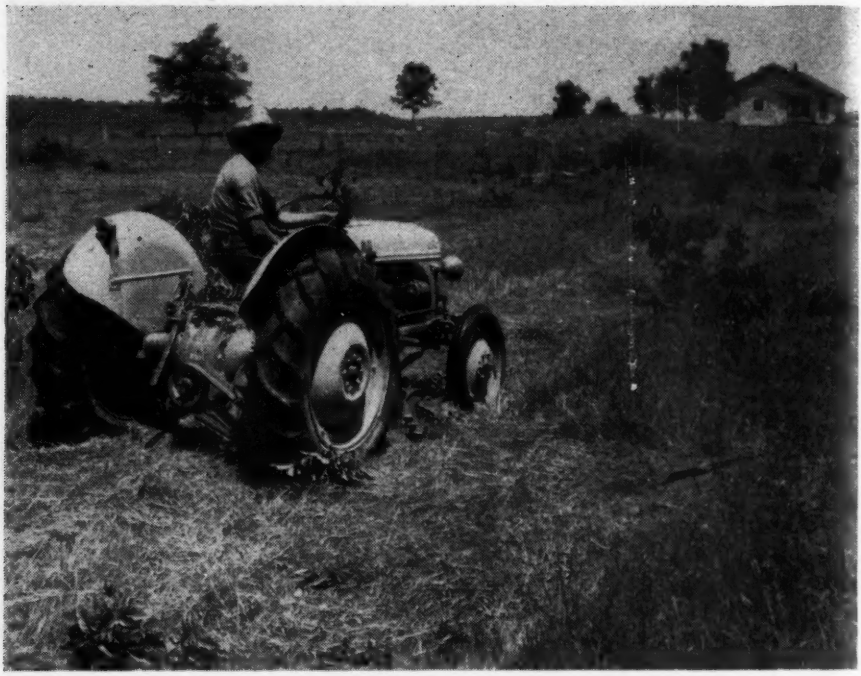
Above: Loafing acres, like these, should be put into good pasture.

Below: Lime should be applied to meet pH requirements.



Above: **Ground should be prepared well in advance of planting.**

Below: **Seed should be planted on a well-fertilized and firm seedbed.**

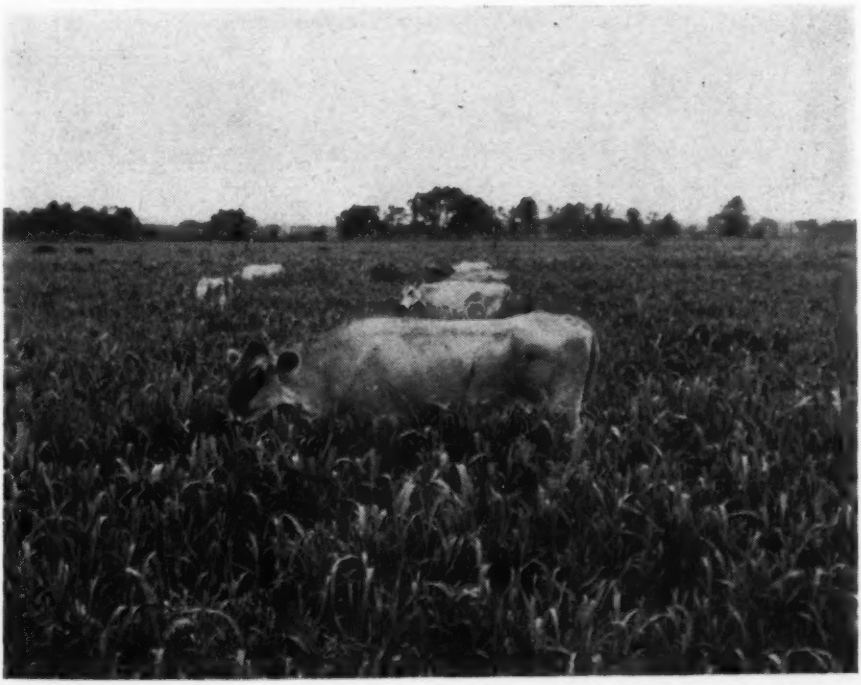


Above: **Brush and weeds can be controlled by mowing.**

Below: **Old sod should be renovated to stimulate new grass.**

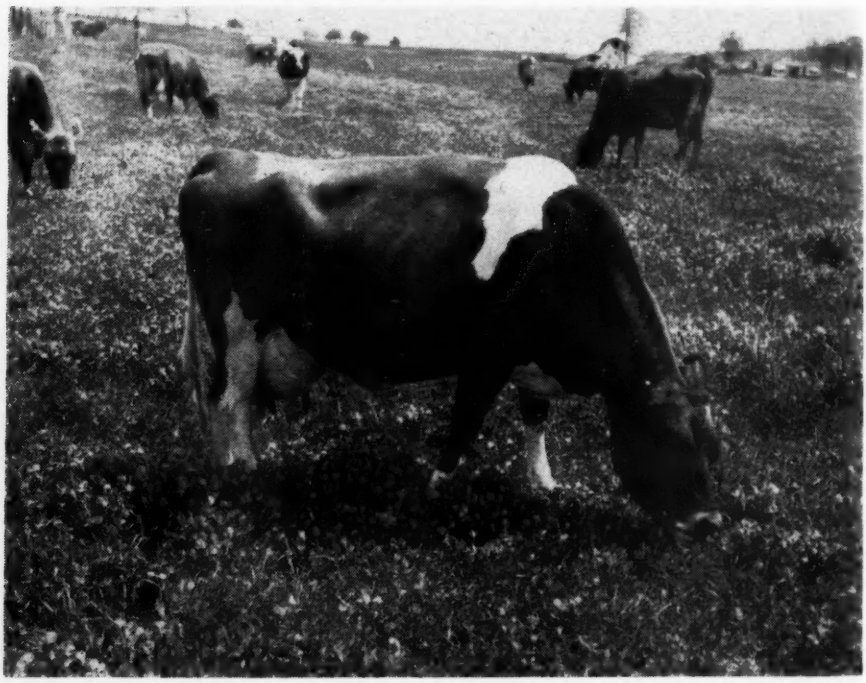
Above: **Permanent summer pasture—Dallisgrass with white clover.**

Below: **Supplementary summer pasture—Sweet sudan.**



Above: **Permanent winter pasture—tall fescue with ladino clover.**

Below: **Supplementary winter pasture—crimson clover, oats, and ryegrass.**



The Editors Talk

Benefiting from Experience

"Agricultural Items" Vol. 5, No. 10, October 1951, published by the Federal Reserve Bank of Richmond, Virginia, carries some good advice to farmers under the above title.

According to the article, "If the farmers in any community were to undertake to rate their own accomplishments, most of them would be rather modest in their appraisals. And this modesty might well reflect a keen awareness of the ways in which their performance falls short of the goals they have set for themselves. Farmers know from experience some of the changes that ought to be made, but because of habit, forgetfulness, and lack of systematic planning, many needed changes are left until some more appropriate time which often never comes.

"The slack season now approaching is a good time for farmers to take stock of their farming operations with the view toward doing a better job in 1952. Now is the time to determine what weaknesses exist, to develop a course of action that will lead to improvement, and to be prepared to put needed changes into effect. While all farmers stand to benefit from such an undertaking, the incentive would seem to be greatest for those who are making little or no progress even in these prosperous times. There are numerous places in a farm business in which wide variation can occur in the quality of a farmer's performance. These should be systematically examined as a means of determining those points at which improvements would strengthen the farm business as a whole.

"Farmers might start by asking themselves just how much each field contributed to the over-all 1951 gross cash income. After allowing for those fields that produced a cash crop and those which produced products that were or will be sold as livestock, many farmers will find that large parts of their farm contributed little or no income.

"It is important that the various fields and pastures be farmed at the intensity which will return the greatest profit. In driving any considerable distance, one passes many fields and pastures that appear capable of producing greater returns if farmed differently. Such casual observation is, of course, of little practical value since only the farmer or someone intimately acquainted with his land can tell whether the farmer would likely find it most profitable to continue as at present, to strive for higher yields of the same crop, to plant some other crop, or to turn the fields into improved pasture or woodland. If farmers, however, would apply what they already know from experience about such matters, the probable effect on farm income would be to provide an ample reward."

It would seem that here are some exceptional opportunities for the agricultural advisory groups to make their work more effective. While a farmer's recollection of the strong and weak points of his 1951 operations is still fresh in his mind, a little advice and urging on the part of an adviser might result in the carrying-out of an improved practice. Winter days lend themselves to such consultations.

The Nationwide Survey on Fertilizer Usage

The U. S. Department of Agriculture has issued a series of regional reports and a national summary averaging the effects of fertilizer usage on crop yields. Using five years of results on thousands of field experiments in each State, a National Soil and Fertilizer Research Committee, made up of agronomists and soil scientists from the Department and the State Experiment Stations, has calculated the increases or decreases in yields that on the average would be obtained with changes in applications of nitrogen, phosphate, potash, and lime for the more important crops grown in the respective regions.

Such a compilation is a valuable aid in determining how changes in fertilizer usage are likely to affect agricultural production. It reveals that marked increases in yield of most crops could be obtained by increasing the use of fertilizers and lime. The results vary, naturally, with crop and region, and the amount of the increase in many cases is influenced by current usage.

Calculations included how much the yield of each crop would be increased on a nationwide scale if 10 per cent more fertilizer were used, 25 per cent more, and so on up to three times the current average rates. It was found that for the country as a whole, the greatest opportunities for increasing yields through fertilization are in grain and forage crops, which receive comparatively low rates now.

While data of this type are subject to the weaknesses of averaging figures, they undoubtedly will serve a very useful purpose in our national planning. From a long-range view, the survey shows quite clearly that fertilizer can be used to increase food production on a tremendous scale and that increased fertilization is equivalent to millions of additional acres. The data also can be very helpful to local agronomists and soilsmen in appraising the soil fertility and crop production potentials in the locality.

Monuments to Ability

Dr. Hugh H. Bennett, Father of Soil Conservation, is stepping down from Head of the Service which has restored millions of the Nation's useless acres to crop production. Effective on November 15 he will yield the post which he has held over the past 16 years to become a Special Assistant to Secretary of Agriculture Charles F. Brannan. The new Chief of the Service is to be Dr. Robert M. Salter, since 1942 Head of the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture.

Dr. Bennett will be missed, for it is probable that in his new duties and advancing years he will not be traveling throughout this country and to far corners of the world preaching the gospel of saving soil—civilization's greatest resource. Over a period of nearly 50 years his enthusiasm and sincere belief in his subject have created a public consciousness in the need for soil conservation that has made this Nation a leader in the movement and himself world-famous.

Secretary Brannan, in announcing Dr. Bennett's new position, said, "I commend him for a job well done for American farmers and for all the people. He has built a strong organization which he can safely leave with the knowledge that it will complete with efficiency the big goals he set for it. I hope that Dr. Bennett will give the world many more years of his talents and energy, but he already has monuments to his ability in every rural area of America where soil conservation is practiced."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops .....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.....	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April.....	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.....	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.....	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.....	39 11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
August.....	34.60	47.7	117.0	273.0	165.0	205.0	15.65	69.10	....
September...	33.73	52.4	123.0	287.0	165.0	207.0	16.55	66.10	....
October.....	36.21	57.7	139.0	271.0	164.0	210.0	17.15	69.90	....

Index Numbers (Aug. 1909—July 1914 = 100)

1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	463	184	244	210	210	139	192	201
1950									
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.....	345	266	154	236	249	240	155	457	265
April.....	348	253	161	231	252	242	155	457	225
May.....	342	398	156	238	255	239	153	448	239
June.....	339	490	155	239	252	235	142	424	189
July.....	315	495	169	249	254	232	130	346	204
August.....	279	477	168	311	257	232	132	306	181
September...	272	524	176	327	257	234	139	293	161
October.....	292	577	188	309	255	238	144	310	171

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per Unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per Unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12 37	10 06	8.68	8.56
August	3.13	2.07	11.94	10.41	8.66	8.66
September	3.13	2.07	11.50	10.78	9.26	9.26
October	3.13	2.07	12.85	11.28	10.56	10.32
Index Numbers (1910-14 = 100)						
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243
August	117	73	341	295	257	246
September	117	73	329	305	275	263
October	117	73	365	320	313	293

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
August	.810	3.98	5.47	.389	.768	14.72	.193
September	.810	3.98	5.47	.386	.768	14.72	.193
October	.820	3.98	5.47	.386	.768	14.72	.193
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82
August	151	110	112	70	81	61	82
September	151	110	112	70	81	61	82
October	153	110	112	70	81	61	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925	156	153	151	112	100	131	109	80
1926	146	150	146	119	94	135	112	86
1927	141	148	139	116	89	150	100	94
1928	149	152	141	121	87	177	108	97
1929	148	150	139	114	79	146	114	97
1930	125	140	126	105	72	131	101	99
1931	87	119	107	83	62	83	90	99
1932	65	102	95	71	46	48	85	99
1933	70	104	96	70	45	71	81	95
1934	90	118	109	72	47	90	91	72
1935	109	123	117	70	45	97	92	63
1936	114	123	118	73	47	107	89	69
1937	122	130	126	81	50	129	95	75
1938	97	122	115	78	52	101	92	77
1939	95	121	112	79	51	119	89	77
1940	100	122	115	80	52	114	96	77
1941	123	130	127	86	56	130	102	77
1942	158	149	144	93	57	161	112	77
1943	192	165	151	94	57	160	117	77
1944	196	174	152	96	57	174	120	76
1945	206	180	154	97	57	175	121	76
1946	234	197	177	107	62	240	125	75
1947	275	231	222	130	74	362	139	72
1948	285	250	241	134	89	314	143	70
1949	249	240	226	137	99	319	144	70
1950								
November	276	255	251	132	85	328	142	74
December	286	257	256	138	88	346	149	78
1951								
January	300	262	261	140	90	351	151	78
February	313	267	268	141	91	358	151	78
March	311	272	269	142	91	357	151	78
April	309	273	268	141	91	353	151	78
May	305	272	266	139	91	334	151	78
June	301	272	265	134	91	311	151	69
July	294	271	261	135	93	297	151	74
August	292	271	258	135	94	294	151	74
September	291	271	258	135	94	300	151	73
October	296	272	259	140	94	335	153	73

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Fertilizer Sales, by Grades 1950-51 Season," Ala. Coop. Crop Rptg. Serv., Office of the Agr. Statistician, Montgomery, Ala., Aug. 17, 1951.

"Effects of Fertilizers upon the Yields, Size and Quality of Orange Fruits," Agr. Exp. Sta., Univ. of Calif., Berkeley, Calif., Bul. 722, Mar. 1951, E. R. Parker and W. W. Jones.

"Lime Fertilizer and Manure for the Home Garden," Ext. Serv., Univ. of Conn., Storrs, Conn., Fldr. 50, Feb. 1951, E. C. Minnum.

"Drilling vs. Banding of Fertilizer for Lima Beans," Agr. Exp. Sta., Univ. of Del., Newark, Del., Bul. No. 291, Feb. 1951, E. M. Rahn.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Shipped to Kansas in the Spring of 1951, by Counties," State Board of Agr., Control Div., Topeka, Kans., Jan. 1, 1951 to June 30, 1951.

"Suggestions for Fertilizing Field Crops in Kentucky," Agr. Exp. Sta., Univ. of Ky., Lexington, Ky., Apr. 1951.

"Fundamental Facts About Fertilizers," Ext. Serv., Univ. of Md., College Park, Md., Fact Sheet 20, Apr. 1951, F. L. Bentz.

"Anhydrous Ammonia as a Source of Nitrogen," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 482, Apr. 1951, W. B. Andrews, J. A. Neely, and F. E. Edwards.

"Fertilizer and Lime Recommendations for New Jersey," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 541, Aug. 1951.

"North Carolina Fertilizer & Fertilizer Materials Tonnage Report, 1950-51 Fiscal Year," "Fertilizer Sales by Grades in Order of Tonnage, Jan. 1, 1951-June 30, 1951," N. C. Dept. of Agr., Raleigh, N. C.

"Yields of Rice as Affected by Different Nitrogenous Fertilizers, Lime and Phosphoric Acid, 1949-50," P. R. 1347, Apr. 2, 1951, R. H. Wyche and R. L. Cheaney; "Fertilizer Requirements for Rice on the Soils of the Gulf Coast Prairie of Texas, 1947-50," P. R. 1348, Apr. 2, 1951, R. L. Cheaney and R. H. Wyche; "Effects of Fertilizers on the Shipping Quality and Yield of Tomatoes in East Texas," P. R. 1353, Apr. 5, 1951, P. A. Young; "The Efficiency of Fertilizer Applications on Dry, Wet and Flooded Soils, As Measured by Rice Yields," P. R. 1355, Apr. 6, 1951, R. H. Wyche and R. L. Cheaney; "Corn Fertilizer Tests in North-Central Texas, 1949-50," P. R. 1360, Apr. 10, 1951, J. H. Gardenhire, J. C. Smith, and D. I. Dudley; "Effect of Time of Application of Various Fertilizers on the Yield of Rice Varieties of Different Maturity, 1949-50," P. R. 1362, Apr. 16, 1951, R. L. Cheaney, R. H. Wyche, and H. M. Beachell; "Correlation of Forage Yields and Soluble Soil Phosphorus on Lake Charles Clay Loam," P. R. 1369, May 14, 1951, L. C. Kapp and R. L. Cheaney; "Renovation and Fertilization of Established Stands of King Ranch Bluestem," P. R. 1371, May 18, 1951, R. C. Potts, L. Reyes, E. M. Neal, L. C. Kapp, and R. A. Hall; Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex.

"The Absorption of Minor Elements by Forage Crops as Influenced by Fertilization and Soils," Agr. Exp. Sta., Va. Poly. Inst., Blacksburg, Va., Tech. Bul. 117, May 1951, N. O. Price, W. N. Linkous, and H. H. Hill.

"How Much Fertilizer Shall I Use?" USDA, Wash., D. C., Leaf. No. 307 (formerly A15-18), Apr. 1951, C. E. Kellogg.

"Fertilizer Use and Crop Yields in the Western Region," Bur. of Plant Industry, Soils, and Agr. Engineering, ARA, USDA, Wash., D. C., Rpt. No. 4, Aug. 1951.

Soils

"The Chemical Composition of Irrigation Water Used in Florida Citrus Groves," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 480, July 1951, I. W. Wander and H. J. Reitz.

"The Agricultural Conservation Program Handbook for 1951 for Idaho," USDA, Pro. and Mkt. Adm., Wash., D. C., 1061, Oct. 1950.

"Iroquois County Soils," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Soil Rpt. 74, June 1951, H. L. Wascher, R. S. Smith, and R. T. Odell.

"Selection of Fields for Growing Sweet Potatoes," Fact Sheet 4, Feb. 1951, E. K. Bender; "Soil Selection Is Important in Tomato Production," Fact Sheet 17, Apr. 1951, E. P. Walls and E. K. Bender; Ext. Serv., Univ. of Md., College Park, Md.

"Terraces on Grassland," Agr. Exp. Sta., Okla. A. & M. College, Stillwater, Okla., Bul. No. B-373, Sept. 1951, M. B. Cox, H. A. Daniel, and H. M. Elwell.

"Land Appreciation," Ext. Div., Okla. A. & M. College, Stillwater, Okla., Cir. 510, E. Roberts.

"Soils and How to Improve Them," Ext. Serv., Tex. A. & M. College, College Station, Tex., Bul. 189, M. K. Thornton.

"A Guide for Soil Conservation District Supervisors," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bul. No. 454, Aug. 1951, M. D. Butler.

"Spencer Soil Can Grow High Quality Forage, Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 396, May 1951, R. Johannes.

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"Soil Survey of Morton County, North Dakota," USDA, Wash., D. C., Series 1936, No. 28, June 1951, M. J. Edwards and J. K. Ableiter.

"Depletion of High Plains Wheatlands," USDA, Wash., D. C., Cir. No. 871, June 1951, H. H. Finnell.

"Soil Testing in the United States—Summary, Comments, Recommendations," Bur. of Plant Industry, Soils, and Agr. Engineering, ARA, USDA, Wash., D. C., June 1951, W. L. Nelson, J. W. Fitts, L. T. Kardos, W. T. McGeorge, R. Q. Parks, and J. F. Reed.

Crops

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"Synopsis of Research Work 1951," Agr. Exp. Sta., Univ. of Ga., Experiment, Ga.

"Tree Planting for Idaho Farms," Ext. Div., Univ. of Ida., Moscow, Ida., Ext. Bul. 185, Apr. 1951, V. F. Ravenscroft.

"Experimental Corn Hybrids 1950 Tests," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., Bul. 543, L. F. Bauman, R. W. Jugenheimer, C. M. Woodworth, D. E. Alexander, and B. Koehler.

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"Windbreaks for Kansas," Ext. Serv., Kans. State College, Manhattan, Kans., Leaf. 9(L-9), Feb. 1951, D. P. Duncan.

"Pasture Improvement," Agr. Exp. Sta., Univ. of Me., Orono, Me., Bul. 488, Feb. 1951, C. H. Moran.

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"Growing Oats in Maine," Ext. Serv., Univ. of Me., Orono, Me., Cir. 267, Mar. 1951.

"The Extension Service in Massachusetts," Ext. Serv., Univ. of Mass., Amherst, Mass., Leaf. No. 172, Rev. Mar. 1951.

"The Dixielee Pea," Agr. Exp. Sta., Miss. State College, State College, Miss., Serv. Sheet 418, Dec. 1950, L. R. Farish.

"Sixty-third Annual Report of the College of Agriculture at Cornell University and of the Cornell University Agricultural Experiment Station 1950," Cornell Univ., Ithaca, N. Y.

"Sixty-ninth Annual Report, New York State Agricultural Experiment Station, Geneva, New York 1950," Agr. Exp. Sta., Geneva, N. Y.

"Farm Science and Practice," 69th A. R., Agr. Exp. Sta., Wooster, Ohio, Bul. 705, June 1951.

"Banks Pine in Pennsylvania," Agr. Exp. Sta., Pa. State College, State College, Pa., Bul. 538, May 1951, H. H. Chisman and W. C. Bramble.

"1950 Trials of Annual Flowers at the Pennsylvania State College," P. R. No. 56; "1950 Marigold and Zinnia Trials at the Pennsylvania State College," P. R. No. 57; "1950 Petunia Trials at the Pennsylvania State College," P. R. No. 58; May 1951, Agr. Exp. Sta., Pa. State College, State College, Pa., R. P. Meahl, L. D. Little, Jr., and S. Atmore.

"Extension at Mid-Century, The Annual Report of the Rhode Island Agricultural Extension Service," Ext. Serv., R. I. State College, Kingston, R. I., Bul. No. 130, May 1950.

"Potato Growing in Rhode Island," Agr. Exp. Sta., Univ. of R. I., Kingston, R. I., Bul. 310, Aug. 1951, T. E. Odland, R. S. Bell, and D. A. Schallock.

"Sixty-second Annual Report 1949," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn.

"1950 Variety Performance Trials of Field Crops," Agr. Exp. Sta., Univ. of Tenn., Knoxville, Tenn., Bul. 218, Jan. 1951, S. F. McMurray.

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"Watermelons," USDA, Washington, D. C., Farmers' Bul. 1394, issued Apr. 1924 Revised Feb. 1951, J. H. Beattie and S. P. Doolittle.

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"Efficient Use of Annual Plants on Cattle Ranges in the California Foothills," USDA, Wash., D. C., Cir. No. 870, May 1951, J. R. Bentley, and M. W. Talbot.

"Okra: Culture and Use," USDA, Wash., D. C., Leaf. No. 305, July 1951, V. R. Boswell.

"Biochemical Changes in Tobacco During Flue Curing," USDA, Wash., D. C., Tech. Bul. No. 1032, Aug. 1951, C. W. Bacon, R. Wenger, and J. F. Bullock.

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Economics

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"The Rural Family and Its Source of Income," Agr. Exp. Sta., Miss. State College, State College, Miss., Bul. 481, Mar. 1951, D. Dickins.

"Keeping Up on the Farm Outlook," Ext. Cir. No. 196, July 31, 1951; "Keeping Up on the Farm Outlook," Ext. Cir. No. 197, Aug. 31, 1951; Ext. Serv., State College of Wash., Pullman, Wash., K. Hobson.

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Judging Native Grasslands

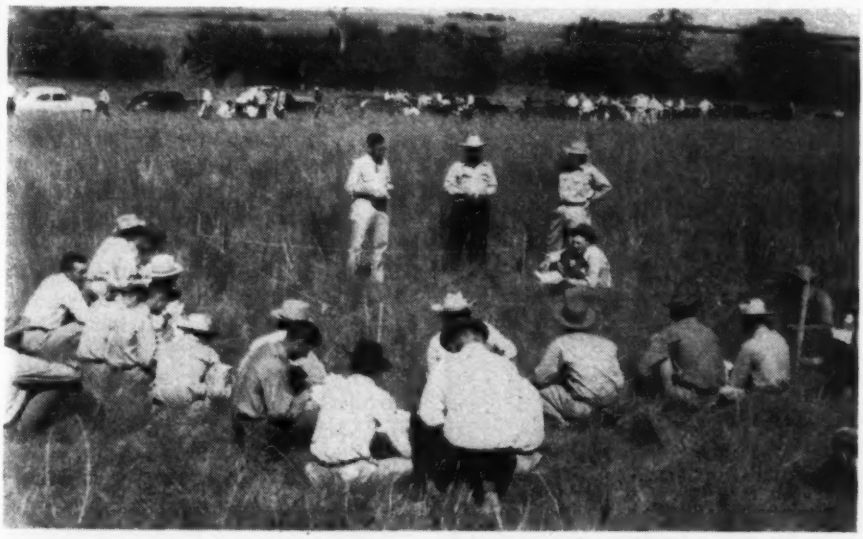
By Edd Roberts

Agronomy Department, Oklahoma A & M College, Stillwater, Oklahoma

OKLAHOMA ranchers and stockmen are participating in range conservation training schools. Native grassland judging contests are popular with the cattlemen.

"Rings of native grass" are judged like a ring or class of beef cows. The judging has contributed to care and improvement of native grass like judging work has contributed to the care and improvement of livestock.

The idea "caught on" after the "land judging" contests started at the Red Plains Experiment Station at Guthrie, Oklahoma. A placing sheet has been designed whereby the contestant de-



A group of ranchers and stockmen participating in a native grassland judging contest near Duncan, Oklahoma.

cides: (1) How hard the native grass has been grazed; (2) the kind of land or site the grass is growing on; (3) condition of the pasture; (4) the conservation practices needed to give the pasture the proper care, management, and protection.

Two pastures are selected in this division to judge. The usual perfect score is about 120 points per pasture.

In addition, two range plant identification judging stations are established. Usually about 30 range plants, grasses, wild legumes, and weeds are to be identified. Besides naming the plants, decisions must be made on such things as determining if the plants are annuals or perennials, warm weather or cool weather, growing native or introduced plants and climax or invader plants. The perfect score runs 5 points per plant. Thirty plants identified correctly total up 150 points. In all, about 390 points constitute a perfect score for a native grassland judging contest.

Ranchers and stockmen spend the morning studying range conservation in a meeting. The contest is conducted in the afternoon.

As a result of this method of teaching, ranchers and stockmen are convinced that "range grasses can be fattened or starved" just as the cow grazing on them. They are impressed with the fact that green leaves manufacture the food required for current plant growth or for "laying on fat" for the future early plant growth. "Fat" for future growth is stored by perennial grass in the roots, crown, and seed. Annuals store up "fat" in seed alone. "Fat grass" out-produces "starved grass." "Fat grass" survives drought, hard winter, and insect damage when starved plants die. Range grass is the basic resource for western livestock operations.

The details and sample copies of the judging sheets may be obtained by writing to Extension Soil Conservationist, Oklahoma A & M College, Stillwater, Oklahoma.

M. V. Corey . . . Grassland Winner . . .

(*From page* 15)

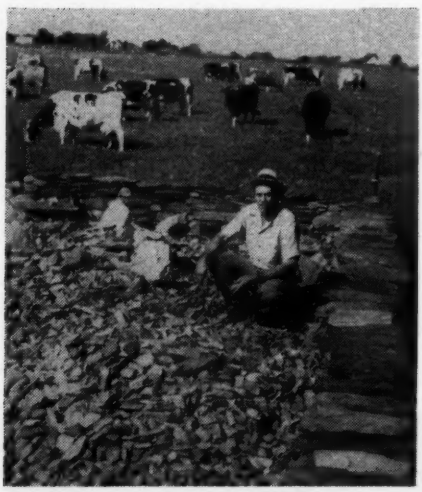


Fig. 2. Mr. Corey still adds to the rockpile which has been accumulating over the years as fields are cleared. Even his winning pastures still yield unproductive rocks.

success of his program to "frost seeding" where he simply throws the seed on the ground in early March. But another practice he strongly advocates is the careful clipping of each field after the cows have finished grazing it. Clipping allows the new crop to start without the interference of "the dead stuff on top," as he phrases it.

This year he started cutting silage on May 30. The first cutting of the heavy, difficultly cured hay fills his two silos with grass silage. Molasses is added. The second cutting of hay provides 3,200 bales of top quality. The silage cutting and filling job was done by June 17. Despite drought periods, he has not had to resort to any barn feeding. Silo capacity is 240 tons.

Newport County Agent Herbert W.

Peabody cites the sustained production record per cow each month from May to November, the average being from 870 to 890 pounds of milk with no additional barn feeding.

Because of the high quality of his crops Mr. Corey will reduce his 16 per cent protein ration to 12 per cent. The cows are in lush pasture night and day, and because of the arrangement of pastures, do not travel far from them to the barn and the resting lot adjacent to it.

A native of the Azores, Mr. Corey came to this country in 1922, at the age of 22. His wife, also a native of the Azores, was brought here when she was less than three. She serves as the accountant and business manager of Whitehall Farm. A son, Manuel, is herdsman. There is only one other full-time employe, a nephew. The silage loading is a custom job.

Mr. Corey grows a cash crop of potatoes, of which he has 33 acres. He has no corn. "It's not dependable because of the weather. Besides, corn makes too much work. Since I get more grass silage and hay than I can use, I don't need to worry."

Corn Research Results . . .

(*From page* 8)

or more per acre. The highest yield among this number was 185 bushels per acre, and 88 per cent of all the test cooperators were 100-bushel per acre producers. During 1950, 266 farmers, 4-H, and FFA members from the same three counties were members of the 100-bushel clubs in Georgia.

By putting down plenty of fertilizer on soil that is well limed, leaving enough plants of an adapted hybrid that was planted early, and by practicing shallow cultivation, striking increases in corn yields may be obtained. In fact, twice as much corn can be grown on half as many acres as were planted to this crop under past methods of management.

This means fewer acres planted to corn and some may say that a problem of land use is presented. But for an area that has never had enough livestock and livestock products, the answer is rather simple. With adequate rainfall and a good average temperature, perennial grasses and clovers are yielding as high here as anywhere in the country. The highest producers of corn are going to grass the fastest, and using corn to the best advantage.

Complete results of the corn tests described herein may be had by requesting Georgia Experiment Station Bulletin 264, Corn Production in North Georgia.

Fertilizer in Japan

(*From page* 14)

termine for any location the response of a crop to various levels of nitrogen, phosphorus, and potassium.

In measuring the crop response to different applications of one fertilizer, the other two were applied at estimated maximum required rates. For example ammonium sulfate was applied to different plots as follows: 0, 13.4, 27.0, 40.4, 54.0, 67.4, 202, 270, 337 and 81 lbs. N respectively, per acre. On these plots 16% superphosphate was applied uniformly at the rate of 108 lbs. P_2O_5 per acre and potassium sulfate at the rate of 202.4 lbs. K_2O per acre. Each plot was replicated three times, making a total of four plots receiving the same treatment. The results from a typical

Fig. 5. Plowing the paddy and transplanting rice seedlings in Japan. Nearly all of the 7,000,000 acres of rice grown is transplanted by hand.

experiment on soil derived from volcanic ash are shown in Table V.

It will be noted that potatoes responded markedly to all three fertilizers although stable manure and some commercial fertilizer had been applied to the plot area in previous years. Under the conditions of the experiment, optimum yields for this crop required approximately 40 lbs. of N, 80 lbs. of K_2O, and more than 108 lbs. of P_2O_5 per acre.

In comparison with the highest yield of 286 bushels shown in Table V, it is interesting to note that the average yield of potatoes for all Japan during the period of maximum fertilizer usage (1936-40) was only 166.8 bushels per acre.

Supply and Utilization of Fertilizer

Opportunity still remains for increasing the production of food crops to a level even above that reached in prewar years. The opportunities with fertilizers lie in two directions: (a) maintenance of an adequate supply of fertilizer materials; and (b) changes in fertilizer practices.

Japan has never had sufficient commercial fertilizer for maximum economic production. Yet the return per unit of fertilizer in terms of increased crop yields is large in Japan. On the other hand, crop production decreases sharply if insufficient quantities of plant nutrients are used. The supply of commercial fertilizers is a critical factor because little opportunity exists for increased use of farm manures. Achievement of increased crop production in

TABLE V.—YIELDS OF POTATOES AS AFFECTED BY VARIOUS LEVELS OF NITROGENOUS, PHOSPHATIC, AND POTASSIC FERTILIZER, KANTO-TOZAN AGRICULTURAL EXPERIMENT STATION, JAPAN, 1950.

Lbs. N per acre applied	Bu. per acre	Lbs. P_2O_5 per acre applied	Bu. per acre	Lbs. K_2O per acre applied	Bu. per acre
0	138	0	97	0	188
13.4	192	21.6	152	40.4	249
27.0	222	43.2	197	80.8	278
40.4	253	64.8	236	121.6	279
54.0	259	86.4	268	162.0	276
67.4	276	108.0	286	202.4	286
81.0	286	.....	.....	.....	.....

the future will depend to a considerable extent on the availability of even larger amounts of fertilizer than were available in 1950.

The Japanese farmer, however, needs to be educated in the intelligent use of fertilizers including the minor elements. It is essential that he learn the importance of time of application in fertilizer usage and the effect on yields of delaying the basic treatment. He knows practically nothing of the effect on crop quality of intermittent applications of fertilizers, especially nitrogen. His knowledge of the possibilities of fertilizer placement has been gained largely from experience, although recent experiments have indicated that on irrigated rice fields attention to the mixing of fertilizer in moderate depth (to approximately six inches) may improve yields as compared to surface applications.

At the present time Japan is importing approximately 20 per cent of its yearly food requirements. Solution of that country's fertilizer problems will go far toward eliminating this deficit. Under the guiding hand of the Occupation, satisfactory progress in this direction is being made.

Concerning "Bio-dynamic Farming"...

(*From page* 24)

sprayed for a long time with chemicals have no longer any biological activity." "The struggle between the microbes themselves maintains a certain ferment of organic activity." "The presence of wormwood, speedwell, and dog's mercury shows a wrong decomposition of the soil—less fermentation but more decay."

The soil is said to be a vital system. Thus: "Contrary to the general popular belief, we feed the soil by manuring. We do not feed the plants." "Especially objectionable is the absorption of the decaying products of half-rotted albumin which may be taken up directly by the plant roots. This can have a disturbing effect on plant and also on human health." "Horse manure being especially a protection against denitrogenizing bacteria."

The "bio-dynamic" groups are actually offering for sale a mysterious bio-dynamic substance to be used as an inoculum for composts. The fact that equally good composts of stable manure can easily be prepared without such supplementary substances is overlooked thereby. All that is required is addition of certain mineral fertilizers, in order to obtain excellent composts from plant residues, such as straw, cornstalks, leaves, and other vegetable refuse.

Much is made of the possible injurious effect of mineral fertilizers upon the beneficial microorganisms in the soil. Certainly, a concentrated salt solution may have an injurious effect upon various bacteria and other microorganisms. In the soil, however, the various fertilizer salts, some of which are identical with those produced by the soil microbes, are diluted and either adsorbed in the base exchange complex or transformed otherwise into less soluble compounds. In the presence of plant residues, microorganisms absorb mineral elements and transform them into microbial cell substance, which becomes a source of plant nutrients and of soil humus.

Part of the blame for the apparent success of the spreaders of these fanciful half-truths is to be placed at the door of some of our "fertilizer experts." They have been so carried away by the tremendous possibilities for increasing crop yields through the use of mineral fertilizers that they have too often neglected to recommend the supplemental use of lime and organic matter. Fortunately, however, the recently accumulating knowledge on vitamins, hormones, and microbial growth-promoting substances, their importance in human and animal nutrition, and their

presence in the organic residues in the soil has again centered popular attention upon soil organic matter and its function in the soil.

No truly serious problem is presented by soil organic matter save that of developing systems for the maintenance of the supply of this very necessary material into wide-scale operation on the farms of this country. What we are dealing with is the practical problem of replacing the large amounts of animal manure that were lost to agriculture by the substitution of the automobile and the tractor for the horse. We now possess the knowledge as to what should be done, although this does not assure at all that it is being done. Vague generalizations, based upon theories that date back to the times of the alchemists, merely confuse the issue and serve no useful purpose.

Improving Pastures in Arkansas . . .

(*From page* 25)

severe weather in winter months. To fill that gap they are maintaining a reserve supply of hay and silage.

Here are the principal pasture crops to consider in making a pasture plan:

Grasses:

Permanent Pasture:

Bermudagrass—Can be grown on a very wide range of soils anywhere in the State and with the use of fertilizer can be grown on soils with low fertility.

Coastal Bermudagrass — On the more fertile soils.

Dallisgrass—On the more fertile soils well supplied with moisture in all of the State except the Ozark Plateau.

Carpetgrass—On the Coastal Plains soils in South Arkansas well supplied with moisture.

Suiter's grass (tall fescue or Ky. 31)—On the more fertile soils and also on the poorly drained soils anywhere in the State.

Orchardgrass—On the more fertile well-drained limestone soils in North Arkansas.

Winter Supplementary Pasture:

Ryegrass — On any well-drained fertile soil or with adequate applications of fertilizer on the less fertile soils any place in Arkansas.

Small Grains—Same as for ryegrass.

Crimson clover—On any well-drained crop land.

Legumes:

Permanent Pasture:

Alfalfa—On the most fertile soils where conditions are favorable. (Suitable acreage is very limited in the upland sections of the State.)

White clover—On the more fertile soils well supplied with moisture. All parts of the State. (Ladino should be used only on the more favorable situations.)

Sericea lespedeza—On any well-drained upland soil. Commonly planted where other pasture crops could not be grown successfully.

Annual lespedezas—On a very wide range of soils anywhere in the State.

Summer Supplementary Pasture:

Sweet sudan—Best suited to very fertile soils.

Pasture Mixtures Commonly Used:

Bermudagrass-annual lespedezas (white clover on more fertile soils).

Dallisgrass-white clover

Carpetgrass-annual lespedezas

Suiter's grass-white or ladino clover

Orchardgrass-white clover or alfalfa.

Fertilizer Recommendations . . .

(*From page* 22)

bushel crop of corn, which requires about 100 pounds of potash during the growing season, will need to have around 500 pounds in exchangeable form in the surface 15 inches of soil. In most Missouri soils there is more potash in the second 7 inches than in the surface 7 inches. We have found that when the potash level reaches 300 pounds per acre in the surface 7 inches, it is no longer a limiting factor in plant growth, except possibly in wet growing seasons. Then potash in starter applications becomes increasingly important.

Where heavy crops of forage, especially legume hays, have been removed, large quantities of potash are taken from the soil. Its need may not be very much in evidence at first, but continuous removal of such crops will further emphasize the importance of this mineral plant food. In our experiments, the need for potash is quite evident after crops of red clover, soybeans, or alfalfa have been removed. On the other hand, where crops like sweet clover have been turned under or where the crops are pastured off, the need for potash does not develop so rapidly. However, this year for the first time potash deficiency is showing up on corn in a rotation of corn-small grain-sweet clover, which has been running 15 years. On an adjoining plot where red clover was used in a similar rotation and the red clover was removed for hay, serious potash deficiencies were quite evident after 10 years.

One of our most significant evidences of potash starvation has been winterkilling of wheat and barley on our experimental plots at Columbia where no potash was applied but where phosphate and nitrogen were used. When 50 lbs. of potash were applied on plots where soil tests showed about 100 lbs. per acre of exchangeable potash, the barley yields were increased from 18.2 to 33.2 bushels per acre. In another experiment where 200 pounds per acre of 3-12-0 were applied to the corn and wheat in a corn-soybeans-wheat-red clover rotation, about 95% of the crop was lost through winterkilling last year; while in the same ex-

Fig. 5. This shows the quality of corn and relative yields produced after 14 years of small grain and soybeans with the treatments as described in Fig. 4.

periment where a like amount of a 3-12-12 fertilizer was applied, there was much better survival and the wheat made 20 bushels to the acre. On this same soil in a similar experiment, the oat yields were increased 20 bushels per acre where fertilizer containing potash was used. When soils are not limed sufficiently and receive but little nitrogen or phosphate, the soil minerals can frequently supply the potash needed for the low yields ordinarily obtained. With the adequate use of lime, nitrogen, and phosphate, the potash supplied by many of our soils can no longer meet the requirements for the higher yield of crops, especially where these crops are removed from the land as forage or hay.

During 1950, when the rainfall was more adequate during the growing season, greater evidences of potash deficiencies showed up on many of our Missouri soils. This can be largely attributed to the fact that the plant roots did not penetrate as deeply as in normal years and were not able to use the potash that might otherwise have been available to them from the subsoil. Such deficiencies showed up especially on those soils where the starter or maintenance application used with seedings of small grains, grasses, and legumes, and with plantings of corn did not contain potash.

Essentially the procedure followed in reducing the calculated risk when integrating our fertilizer recommendations with soil tests in the use of nitrogen, phosphate, and potash is:

1. Apply the nitrogen over and above the average released by the soil and the barnyard and green manure added, on the basis of annual needs to meet the planned yield requirements.
2. Bring the phosphate and potash up to the desired level and endeavor to maintain this level through starter or maintenance applications with seedings of small grains and plantings of row crops, based upon nutrient removal by the harvested crops.

When land is seeded to pasture the situation is somewhat different because one does not have as good an opportunity to get the starter or maintenance phosphate and potash into the soil, as is the case with row and small grain crops grown in rotations. It is therefore usually advisable to retest the soil each 6 to 10 years and bring up the levels of these minerals again when renovating the pasture. Since nitrogen is mobile, however, it can be added to pasture crops as topdressing on the basis of their immediate, or annual needs.

As we know, limestone is also relatively immobile in the soil and its level should be brought up in much the same way as for phosphate and potash. We do not normally plan to maintain its level in the soil, however, as we do with nitrogen, phosphate, and potash, through the use of starter or maintenance applications. A retest should be made of the soil each 6 to 10 years and the level again brought up in much the same way as with phosphate and potash on pasture.

We base the need for lime on the history of liming on the field in question and the exchangeable calcium and acidity, or pH tests. For instance, if a silt loam soil has been limed 2 or 3 years and the lime worked well into the surface 7 inches of the soil, and the calcium and acidity tests do not indicate that more is needed than applied, no more is recommended. If, however, only two tons per acre were applied and worked well into the soil within this period and an exchangeable calcium and acidity, or pH, test indicates a need for four tons, the difference of 2 tons is recommended.

If exchangeable calcium tests show medium, or between 4,000 and 5,000, pounds, and the acidity test is medium, or the pH range is between 5.5 and 5.9, two tons of limestone are recommended. When the acidity, or pH test, is the same (medium acidity or

between pH 5.5 and 5.9) and the exchangeable calcium test is very low, or less than 2,800 pounds, we would recommend three tons of lime per acre. If the exchangeable calcium was very high and the acidity and pH range was the same as above, the amount of limestone recommended would be reduced to one ton per acre.

When the acidity test shows very slight or the pH range is around 6.5 but the exchangeable calcium is low or very low, as sometimes happens on our low exchange capacity soils, no more lime is needed to change the soil reaction, but some calcium as plant food then becomes advisable. Under such circumstances only small applications of lime are recommended. These are usually drilled or worked into the soil with seedings of small grain or with grass and legumes. Where heavy applications of rock phosphate are used according to recommendations, however, this need for extra calcium is usually met. Our 26 county laboratories that are equipped to measure both the pH and the total hydrogen are in a better position to determine the soil situation, especially in regard to the need for lime.

When a plant removes basic ions, such as calcium, magnesium, or potash, from the exchange spots on the clay, it leaves hydrogen to replace these ions. The exchangeable hydrogen can, therefore, be looked upon as a measure of the amount of spots devoid of bases in the exchange complex of the soil. A soil with a low pH, such as pH 5, has a low saturation with basic ions. On many soils that have not already been limed or the limestone has not been completely mixed, or where it may not have been on long enough to react with the soil, the tests will show a high reading for exchangeable hydrogen. The presence of unreacted limestone in the soil may, however, affect the pH reading. This fact furnishes helpful evidence as to whether or not a soil has been previously limed. This and the measure of the total hydrogen will therefore furnish a better measure of the lime needs and the percentage saturation of the soil with basic ions.

Fig. 6. Corn in an Ozark field will equal the best in Missouri if the rock-bottom land is treated right with ample plant food according to soil test recommendations. This field was entered in a State-wide corn yield contest and was estimated to run 15,000 stalks to the acre and equal the 1950 yield of 140.1 bushels. This land previously produced only 35 to 40 per acre. The increase was obtained by bringing up the fertility level through deep applications and keeping up this level by starter or maintenance applications with the crop.

Our tests for exchangeable magnesium are used in two ways—to determine whether more of this mineral is needed directly as a plant food and whether it should be used because of a wide calcium-magnesium ratio. For example, if the test for exchangeable magnesium is high or very high, over 600 pounds per acre, it is not likely that more will be needed as a plant food. If the test is low or very low, less than 200 pounds per acre, it is fair evidence that more of this plant food is needed to meet the requirements for a high-yielding crop.

Now where the tests show between 200 and 600 pounds of exchangeable magnesium per acre, the ratio between this and the exchangeable calcium is used to determine whether there might be a deficiency of this nutrient. If this

ratio is as wide as 20 pounds of calcium to 1 pound of magnesium and the soil tests for exchangeable calcium and acidity, or pH, indicate that more limestone is needed, the best method of meeting the needs for it would be through the use of dolomitic or magnesium limestone. By using this method, the magnesium level in the soil would be brought up and the requirements for this mineral should be met for several years through the reserve supply added.

However, on these soils that have been adequately or over-limed with calcium limestone to the point where the tests showed additional limestone might raise the pH too high or if more calcium limestone was used it might cause the calcium-magnesium ratio to become even wider, magnesium in some other form would be advisable. Such applications would then be on the annual or short-time basis rather than a basis to bring up the level or reserve supply as is done with magnesium limestone. In such cases, should the soil indicate a need for potassium as well as for magnesium, sul-po-mag could be used to advantage. This contains 22% K_2O and 18.5% MgO. In those cases where neither limestone nor potassium was needed, magnesium sulphate, trace minerals containing magnesium, or fertilizers—usually used as starter or maintenance applications—containing trace minerals including magnesium could be used. Since most Missouri soils contain more magnesium in the subsoil than in the surface, it would usually be advantageous to plow deeper in order to bring up some of this magnesium. For those soils that have acid clay subsoils this might also be an advantage, when they have been overlimed, by reducing the pH and helping narrow the calcium-magnesium ratio. On low organic matter soils the addition of barnyard or green manure, or organic matter in some other form, should be helpful in buffering the imbalance of the calcium-magnesium.

In conclusion, might I repeat that the fundamental idea in our whole soil-testing and soil-fertility program is to reduce calculated risks to the minimum through the use of soil tests as the basis for soil-treatment recommendations, in order to eliminate plant food as the limiting factor in crop production. We endeavor to do this by bringing the minerals up to the desired level. We apply the nitrogen needed, more on the annual basis, to supplement that released by the soil and the organic material added. We also use starter or maintenance applications of phosphate and potash and in some cases magnesium and calcium, where they can be properly made, to help meet the immediate needs of the crop for these minerals and to help maintain their level in the soil.

What's the Right Answer? . . .

(*From page* 5)

Now to pursue this hunt a bit further, there are professional information workers serving the private field for hire, and another group of (some say) alarming numbers, who serve the states and the federal government for a graduated scale of remuneration fixed by law. At first glance you'd say these two related and similar sets of information people perform their jobs in the same way in general, and therefore usually endorse each other's activities. But this would be a pardonable error for the laity. They do not work exactly alike and their ordinary professional alignments and associations are seldom shared in common.

Having belonged to both the private and the public schools of this profession during nearly 40 years of information service, I can look fairly and objectively at both. Both groups have

at least one sad item of common experience—each has its share of misfits, frauds, and phonies. But in a larger sense and to the glory of the profession, it has been our experience that information of either private kinds or in the public service has been adorned with a mighty fine, capable, and honorable set of producers. The time-serving element has been definitely in the minority.

It is true, however, that too few opportunities are afforded for the members of the commercial and industrial information squads to belong to the same societies and professional groups as those working for the public—with at least one major exception. This body to which masculine devotees of high professional ethics and standards of information belong regardless of the units they work for is known as Sigma Delta Chi, a society, by the way, which had its origin in the academic fold, nursed by the alma mater as it were, and is therefore closely akin to public service in its highest essence. Its pioneers and many present leaders are able information personnel employed by states or the federal government. (The "gals" have their own similar working professional society, be it known.)

NOW in an everyday practical sense, there are extremely close relations between the working press and radio operators and the folks who write the "hand-outs" and bulletins and background information sheets on behalf of the public institutions. Such routine mutual associations should acquaint the private information folks with the performance of their public cousins. Likewise, it does separate the sheep from the goats in the eyes of the public service men, as they deal with the inquiring personnel who put their stuff on the wire or on the air.

Yet too often we read snide editorials and see "colored" news articles, in which the fellow who tries to "shoot it straight" for the government is held up to ridicule as a nuisance and a needless burden on taxpayers. Too often such statements appear in the very newspapers and magazines whose reporters and editors have received much constant help and relied quite generally upon the integrity of the public information officers. It's worth noting, however, that if you corner one of these worthies and ask him his honest opinion, he'll say that his own newsbeat is so large and so complex that without aid from public information men and women his job would be a lot harder and less effectively done. He makes no bones about that, and certain recent questionnaires in respect to public information sources submitted to experienced newshawks and editors bear it out.

ONE other difference exists between the private and the public purveyors of information. Accuracy is the first and foremost ideal of the whole profession, but the two branches go at it according to different methods. The routine, ever-ready commercial reporter, who "sells" news and features to make a living and make a newspaper pay, seldom agrees to submit his copy to an authority whom he has quoted or discussed. In fact, a few of them are insulted at any such suggestion. They rely on their own eyes and ears to get it right. Their resultant danger from overstatement or unconscious bias or misinterpretation is often great and harmful. They work so fast that few lawyers hired to ward off libel can keep up with them.

Yet—and here we tread on slippery ground—the public institution reporter and information writer is invariably required to get "clearance" or what amounts to an O. K. from the scientific or administrative authority he quotes or relies upon. This makes the copy more authentic. I hasten across the "slippery" spot by saying that this is not usually "censored" or "classified" information of the kind which prying reporters so often claim is being withheld or deftly evaded. That is in a special class of its own and

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has no bearing on the ordinary routine give and take between the sources of public information and those who release it and distribute it to readers.

Despite the fact that there are many hundreds of college courses and scores of college departments teaching journalism today, the whole profession is too loosely organized and buttressed. Its ineffective free-for-all system invites those with little training or background to enlist and proclaim themselves past masters. I honestly think that information people are just about at the stage of medicine and surgery back in the middle ages. That is, any charlatan or conjuror, mountebank or adventurer who could pull a trick cure out of the bag was able to get a host of credulous followers and victims.

WE have in the agricultural information profession no fixed rule for advancing aspirants to a fling at the works. Of course, there is a behind-the-scenes idea that to succeed in farm information work and become an ornament to the profession, one should be raised on a farm of some kind and have had more or less academic training in both agriculture and journalism.

But the demand for new publications and new radio programs and such avenues reaching the farmer is keen these days. In our Southwest region there are more regulation newspapers publishing extra supplements than the standard agricultural press itself can boast, either in numbers or total circulation. The fact that a bulk of those daily newspaper readers are not farmers doesn't conflict with this thesis. One who tries to interpret and explain agriculture and its risks and problems to the urban dweller is a mighty potent force, for good or ill. Unless all our citizens come to know the facts of life in agriculture—as in labor—an opening for bitter cleavage is a nasty threat.

By this I do not insist that we must educate tyro information guys to become selfish special pleaders. What

we want in them is broad understanding and not a quick and skimpy newshawk's hunch. It has become a frequent practice among public institution informationists to put too much emphasis on puffs and boosts for their college or their department, and forget the basic reason for the existence of the institution—which is to serve the public and help it avoid pitfalls and overcome obstacles.

Spending public money to salve or oil up some executive or anticipate some smart political maneuver by cooking up another smarter one is not in the code of the best professional informationists. The mere boastful recital of power or privilege, without showing how our people have derived some benefits and encouragements from governments or other public institutions, is debasement of the craft.

BUT like all fragile and vulnerable human things, our information is subject to vagaries and whims and misdirected effort. It can never be perfect. It can hardly ever know for sure that what it proclaims is the truth —at least as to whether it will be the truth tomorrow. But if it manages to escape dishonest manipulation for greed or narrow glory, its future service to men of good will should be a credit to the profession.

Some of us have had but humble and obscure parts to play in the upholding of a standard of ethics and nobility for information writing. Many of us have not seen clearly what we were expected to demonstrate or explain. We have all sinned by omission or commission or both. But let's vow to carry forward the ideals and defend those whose daily work has been worthy of the hire. Information is so close to the foundations of our very existence and welfare that he who tinkers with it or attacks it wholesale is quite apt to be anything but a "statesman for the ages."

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Seven sailors and a lady, shipwrecked on a desert island, were rescued after five long years.

One of the sailors, upon his return home, was relating his experiences to a very straight-laced and pious old aunt. Finally, after much hemming and hawing, the old lady asked:

"And, my boy, was the lady chaste?"

"From one end of the island to the other," replied the sailor.

* * *

One thing you've got to admit about the little red schoolhouse—it had something in back of it.

* * *

"Darling," a mother reproved her daughter, "you were awfully late last night. I'm afraid I'm dreadfully old-fashioned, but I should like to know where you go."

"Certainly, mummie. I dined with—oh, well you don't know him—and we went to several places I don't suppose you've been to, and finished at a queer little club—I forget its name, but it's in a cellar somewhere in town. It's all right, isn't it, mummie?"

"Of course, darling. It's only that I just like to know."

* * *

A young husband was telling his wife about a couple who had just had twins.

"And just think," he said, "twins happen only once in 13,350 times."

"My," said the young wife, "when did she have time for her housework?"

"Now, children," smiled the Sunday School teacher sweetly, "I want you to be so still you can hear a pin drop."

After silence had reigned for an interminable 30 seconds, a kid in the corner yelled, "Okay. Let 'er drop!"

* * *

"Last night," reported Private Higgins, "I finally persuaded my girl to say yes."

"Congrats," said his buddy. "When's the wedding?"

'Wedding?" said Higgins. "What wedding?"

* * *

The naked hills lie wanton to the breeze,
The fields are nude, the groves unfrocked;
Bare are the shivering limbs of shameless trees.
What wonder is it that the corn is shocked!

* * *

It was in one of those North-South intersectional football games. A Southern halfback was tackled terrifically hard. The impact stunned both boys. When their heads cleared the Southerner said good-naturedly, "You-all sure hit hard."

"You-all, my eye!" retorted the Northern tackler. "I did it all by myself."

* * *

"Hey, pop!" said the son, "Watcha doin' kissin' the maid?"

"Bring me my glasses, son," said pop. "I thought it was your mother."

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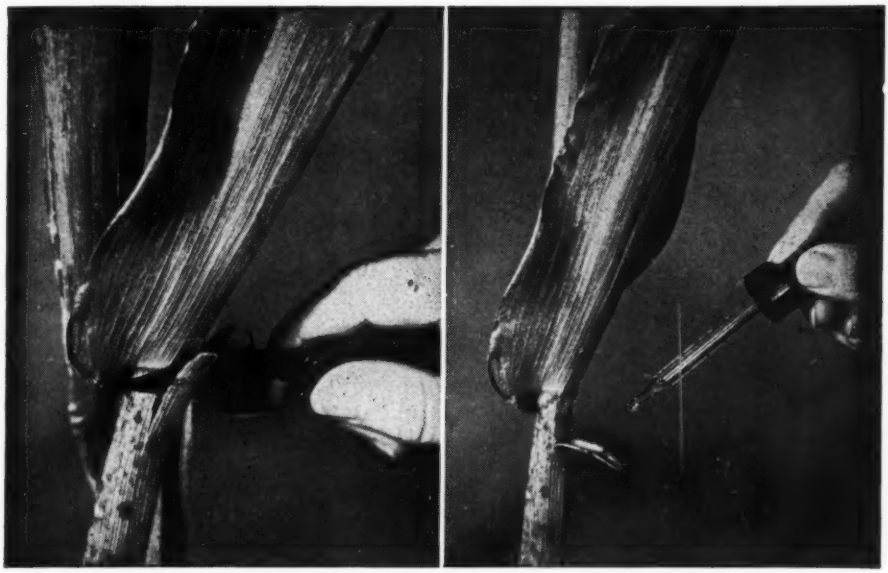
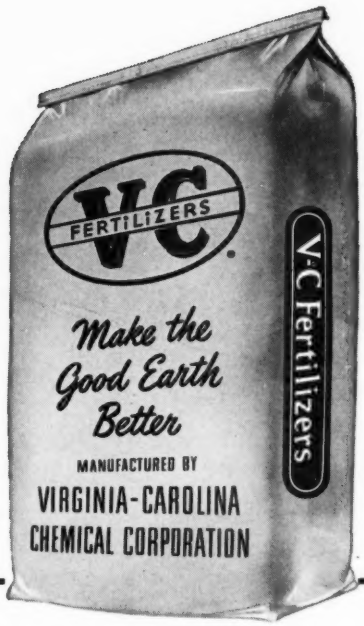


Nitrate tests can be made at the base of the leaf midrib without destroying the entire plant. This is an important consideration in making numerous tests on small experimental plots. The height of the plant at which nitrates are present as well as the intensity of the blue color gives an indication of the nitrate status of the plant.

Equipment used in a well-developed laboratory for soil analyses.

See why so many FARMERS prefer it!



Ask a V-C Agent to show you some V-C Fertilizer. Look at the rich color of this properly-cured, superior blend of better plant foods. Run your hands down into the smooth, mellow mixture and let it pour through your fingers. It's mealy, loose and dry.

V-C Fertilizer is famous for its crop-producing power and its easy-drilling quality. It flows through fertilizer distributors smoothly and evenly with no caking, clogging or bridging.

The better plant foods in V-C Fertilizer are carefully selected and proportioned to become available according to the feeding schedule of the crop. That's why a V-C crop gets off to an early start of rapid growth... and then stays on the job, green and growing, vigorous and productive.

V-C Agronomists use Experiment Station and Extension Service recommendations and practical farm experience in determining the right V-C Fertilizer for each crop.

Every bag of V-C Fertilizer has behind it the research, skill, experience and resources of a national organization which has manufactured better fertilizers since 1895.

You will know why so many farmers prefer V-C Fertilizer when you see what a big difference this better fertilizer makes in crop yields and crop profits.

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